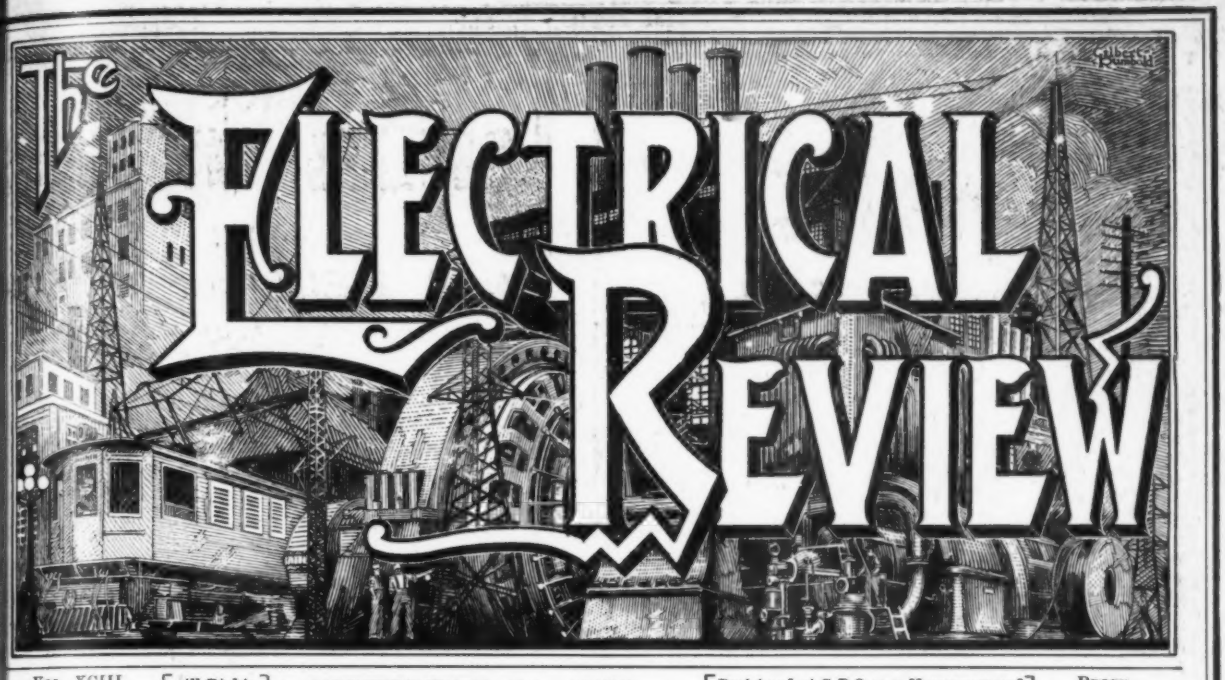

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ENGINEERING INDUSTRY.

ON Thursday last week a dinner was given at Olympia in honour of Overseas visitors to the Shipping, Engineering, and Machinery Exhibition. A more than usually interesting after-dinner speech was delivered by Lord Aberconway, who, after striking the right note by saying that there was no lack of inventive power, commercial energy, and workmanship efficiency in this country, dwelt with emphasis upon the present depression in our shipbuilding and engineering industries. In forty years' experience he had not known any period when there was such depression, and there never was a time when those industries were in greater need of support. He found it impossible to say that there was a single branch of the engineering trade which was in a flourishing condition, and was greatly concerned with the question: "Would the trade ever come back?" There was no doubt concerning the absorbing capacity of the world for such manufactures, but would the trade come to us or would it go to Germany?

His Lordship probably is quite aware that at the present moment engineering firms are up against ruinous competition from other foreign producers as much as, or even more than, from those of Germany, in respect of some classes of plant and machinery. The appeals of the Government to British public authorities to place orders with British firms in order that unemployment may be lessened are being complied with in many towns where municipal corporations are in the market for extensions, but, unfortunately, in far too many large industrial concerns the disposition to show price consideration so as to keep orders at Home seems to be wanting.

Lord Aberconway mentioned German quotations for a ship which were 40 per cent. lower than the lowest British offer; also a German estimate for colliery winding plant which was 25 per cent. below the lowest English quotation. British electrical and allied manufacturers could quote numerous cases where big industrial undertakings here have placed with non-German Continental works orders, which we badly need, for machinery and plant. The figures quoted by our firms were, it is true, substantially higher than the foreign offers, but sometimes, even if British firms desired to revise their tenders, with the intention of supplying without any profit if need be, or even at a loss, in order that work might be in hand for their workpeople, they have not been allowed such privilege. We are fully alive to the responsibility of advisory engineers and boards of directors to the shareholders in whose interests they follow their calling, but it is unthinkable that such authorities should overlook the immediate importance of providing work for British workpeople, the obligation that should rest upon them to safeguard the national industrial position, and the need for reducing taxation by lessening the unemployment burden which hangs so heavily about the neck of all British industry. In their regard for capital economy they do not act in their shareholders' ultimate interests if they fail to pay due heed to such matters as working efficiency and lasting quality. Mr. J. T. Brownlie has this week been appealing in an A.S.E. speech to the Government to find work for unemployed engineers, and he discounts such work as roadmaking and reclamation of foreshores, because it is not work for which highly-trained skilled engineers are fitted. Yet all the while engineering work which is

essential and has not to be *made* is being placed abroad by British industrial concerns.

Returning to Lord Aberconway's speech, we note that he laid stress upon the necessity for cutting down British production costs if we were to compete with great manufacturing countries like Germany, whose costs are negligible compared with our own. Part of the British Government holds that only if Germany be forced to pay reparations, will there be fair play in international competition. There can be little doubt that such is the case, always providing that those reparations are not paid in kind—an operation which would make international competition worse instead of better.

A later speaker (Sir J. Fortescue Flannery) expressed the conviction that the knell of our industrial death had not yet sounded, and that, with wiser counsels, we should yet regain our old supremacy. The wiser counsels which he had in mind related to the assistance which British workpeople could render in keeping the industrial wheel in prosperous motion if they would recognise the folly and wickedness of striking and standing idle when by working well they could help to secure business which was keeping Continental countries full of orders. Furthermore, costs of production in this country were increased by unwise speeches from socialistic orators, as well as by lack of settlement of reparation claims.

It cannot be emphasised too often that the unemployment that exists in this country is to a considerable extent due to the attacks upon capital. The threats of what the workers will do to obtain the control of various industries are as stale as they are shortsighted, but they are nevertheless dangerous. They were at their loudest during the war, but when the demand for manufactures of war descriptions was so immense they were powerless to affect the expenditure of capital. We dealt with the subject somewhat fully at that time and recognised that it was one of the after-war questions which would demand attention in course of time, but it was difficult to get labour-leaders to say exactly what they meant by "control" and what it was they meant to "control" if public opinion approved the principle. Five or six years ago if the nation had not been operating under war control the inflammatory and disturbing speeches might have brought the war-winning machine to a standstill. Nowadays, however, these attacks on capital and the plans of visionaries drive capital into safe channels where such ideas as confiscation and control are less menacing. They leave everybody discontented save the orator himself.

The free flow of capital consequent upon the existence of full confidence would do immediate good to industry and would create employment, while the absence of "control" speeches would mean more contentment among our people and an ability to give better work, thereby reducing production costs, so that competition could be more easily met. It is remarkable that audiences can be found, while Rome is burning, so to speak, whose fancies are tickled by speeches on the socialisation of industry. For example, addresses were delivered at a Summer School of the Independent Labour Party on the transformation of non-monopolies into public services. The Budget Policy of a Socialist Government, it was declared, would tend to increase the effective demand for necessities and repress that for luxuries; the great textile and metal industries were taken as examples of trades to be encouraged, and one speaker indulged in fanciful speech regarding the prospective effect of the development of municipal and co-operative enterprise on the control of the "electricity industry." This to-day (see *Daily Telegraph* report of the speech) "was largely in the hands of rings and trusts controlling the production of plant." "With an all-municipal electricity service controlling the home demand, the position would be altered." Now, we thought we knew a little about the movements in progress in the electrical industry, but we suppose the Summer School orator knows more—or thinks he does. It might be that practical acquaintance with an industry which represents about 600 millions sterling, knowledge of the beneficial results that organisation has brought to that industry, data as to the cut prices which obtain in its ranks in order to secure work—profit or no profit, the advantages that private enterprise has brought to electrical development, the benefits of co-operative action in the same connection and in respect of research,—and some other things, would water down the socialistic idealism in electrical directions at any rate.

The "control" of working conditions in industry through the medium of industrial councils or works committees is one thing and has widespread general sympathy and support, but "control" of industries themselves by public ownership is quite another matter, signifying such an upheaval as would ruin everybody. We should have supposed that there had been sufficiently disastrous experience of the shackles of "control" upon various trades during war-time. Dreams of better conditions for workers, lower economic production costs and larger output per man, and greater prosperity for international trade, under State control, are dreams and cannot be anything but unpractical idealism, but oratory of such an order is just the sort of thing that makes for restlessness and discontent among the workers and for nervousness among those who can, if they choose, divert capital into industrial courses. It conduces to inefficient and insufficient work and to the continued investment of capital in trustee securities.

Railway Electrification.

On Saturday last Dr. Macnamara, speaking at a meeting at Chobham, urged that the railway companies should press on with electrification schemes, the particular point in his advocacy being that it would give employment to skilled artisans. Dr. Macnamara, in thus pressing for an early putting-in-hand of railway electrification, is, of course, only adding to the almost universal clamouring, inside and outside of the House, for railway companies to take immediate action in this way. The railways particularly in mind are the Great Eastern, Great Northern, and London, Tilbury and Southend. The South-Eastern is, of course, already pushing ahead, as also is the Brighton Railway. The South-Western has made more than pious resolves, but so far we have not heard of any definite progress being made.

There certainly seems to be every reason why electrification should be undertaken at the earliest possible moment. The unemployment factor bulks largely in the problem, but there are also other factors which, without having the same dramatic appeal, are of more permanent consequence, and those are: increased railway facilities (and all their industrial consequences), the augmentation of electric power generation at central sources, and the possibility of bulk supply to areas *en route*. All of these matters are factors in the industrial resuscitation of the country. In this connection we note an article in Saturday's issue of the *Financial Times* commenting on certain vast electrification schemes, mainly centring about electrification of the railways which are to be seen developing in France, and especially the Pyrenees hydro-electric system. The writer remarks: "A little more than a year ago British investors subscribed £15,000,000 to help finance French railways, though the money could have been put to similar use on our own systems, and thus have materially assisted in mitigating unemployment." The article goes on to point out that the Pyrenees hydro-electric scheme will enable power to be supplied "on terms that will make the South-West of France one of the most formidable industrial competitive areas in Europe."

Altogether the convergent arguments for a speeding-up of our own railway electrification schemes ought surely to lead to an early materialisation of certainly the chief projects.

Continuous Transportation.

Exactly twelve years ago Mr. W. Yorath Lewis described the Adkins-Lewis system of continuous-service passenger transportation before the British Association; from the description of the demonstration railway that has been constructed at Southend, which appears elsewhere in this issue, it would seem that in the main the design is unchanged, the chief alteration being the adoption of a slow-pitch screw at station platforms (in the earlier proposal the cars were to push one another across a gap between the ends of the screws). At the time we expressed the opinion that whilst the system might be serviceable for short distances, it did not appear to be applicable to dense traffic, such as that on the London underground railways; in the interim that traffic has enormously increased, and to cope with it great improvements have been made in the services of electric trains, which can now carry some 25,000 passengers in each direction at an average schedule speed of 18 to 20 miles an hour. The promoters of the "Never-stop" system claim to be able to carry 30,000 persons per hour at the same average speed, but is this practicable? If they provide a platform 50 ft. long for passengers alighting, and one of the same length for passengers boarding the cars, and if the cars pass these at a speed of 4 ft. per second—the maximum that can be contemplated—they will spend 25 seconds in each station; with stations half a mile apart, the cars would have to attain a maximum speed well over 30 miles an hour to give a schedule speed of 20 m.p.h.

The "Never-stop" system converts the railway into a huge machine, and, with all respect to the virtues of a name, we venture to suggest that it will stop sometimes; no machine was ever made that was immune from failure. It will be necessary therefore to provide effective means for dealing with such emergencies and for securing the safety of passengers. The latter will also need careful marshalling on the platforms, and perhaps in the cars—it has even been suggested by a tramway expert that a conductor will be necessary in each car, in which case the anticipated saving in labour will not be realised.

However, Mr. Yorath Lewis has had a long time for reflection on the various difficulties which he has to confront, and if he displays the same ability in dealing with them as he has exhibited in the design of this exceedingly ingenious system of transportation, the scheme may prove suitable for many applications.

Electricity Supply Tariffs.

Having shown in recent issues of the Electrical Review that there is justification for a general lowering of the prices charged for electrical energy in this country, Mr. H. M. Sayers, elsewhere in this issue, discusses the systems of charging in vogue, and recommends the adoption of a low flat rate for the encouragement of the domestic load. Such a tariff certainly has the merit of simplicity, but whether it is best calculated to develop the use of electricity in the home is not so certain, for it necessarily involves a fairly high price per kWh irrespective of the purpose for which energy is required, and, therefore, of the incidence of that particular load. It is true that Mr. Sayers's tariff is based upon a system of classification of consumers, but it offers no inducement to them to increase their consumption of electricity for heating and cooking. On this account we prefer either a fixed payment per quarter plus a uniform low price per kWh, or the system outlined by Mr. W. W. Lackie in his I.E.E. paper of 1912. Mr. Lackie carried out an extensive investigation at Glasgow, and ascertained the normal consumption of certain classes of dwellings for lighting only; he then devised a tariff which in effect charged 3d. per kWh for energy used for lighting, whilst all energy consumed beyond that nominally allocated to lighting was charged for at 1d. per kWh. Such prices cannot now be offered—except, apparently, by certain small undertakings, which can and do supply their customers at much lower rates than many of the big ones—but the principle holds good just the same, and it cannot be doubted that this system promotes the use of cookers, radiators, irons, and other accessories which by virtue of their high diversity factor and off-peak incidence are entitled to a low charge. Such a tariff also permits of the use of lamps for long hours (which, when off the peak, are equally entitled to a low charge), whereas a system under which lighting is charged for at a high fixed price and heating, &c., at a lower price tends to restrict the use of lamps whether during or off the peak, to the detriment of the suppliers' revenue.

Having in view the extent to which this subject has been debated during the past quarter of a century, it is amazing to look round and see how many authorities still adhere to crude and inefficient systems of charging, often involving the use of two meters and separate wiring, and this not only to the disadvantage of their consumers but also to their own loss.

The British Association.

The brief session of the British "Parliament of Science" came to an end on Wednesday last. It has had a "good Press," but once again a murmur of "*Cui bono?*" is being heard.

The world is full of practical people who want to see results—by which they mean financial gains. They cannot see, for instance, what the study of the atom has to do with the realities of life, and they are, therefore, content to leave such things to the scientists—using the term almost as one of opprobrium. The subject employed as an example did once possess possibilities, but Sir Ernest Rutherford has disappointed the "realists" by expressing doubts as to the amount of energy that the disintegration of the atom would set free.

Nevertheless, we believe that this annual linking-up of various branches of thought and research is of considerable benefit to the people at large. Many of the subjects raised are perhaps of problematical utility, but at the same time many others either direct further research towards useful discoveries and inventions or are of immediate practical value provided the necessary imagination is exercised in their application.

It may be said at once that all the papers read before the Engineering Section were of a practical nature. Some were merely reviews of recent progress, others published for the first time the results of experiments leading towards definite improvements in structures and machines, while a third class outlined ideas for immediate adoption or put forward suggestions for the solution of outstanding difficulties.

Many other practical matters were dealt with, as will be seen from the abstracts and reviews which we are publishing this week and subsequently, and we are certain that these alone will furnish abundant proof to our readers that the Association is not merely a body remotely concerned with realities, but is really a progressive institution contributing largely to the health and wealth of the world.

Sincere Flattery.

A prospectus recently issued in connection with a new "switch" for gas lamps is noteworthy for its candid acknowledgment of the superiority of electricity. The appliance is said to be "a simple and inexpensive device for lighting and extinguishing the gas at a distance, in the same convenient manner as with the electric light"; again, "Every gas company in the United Kingdom has been seeking for years the means of putting its commodity upon a level with electricity." The "gas switch renders gas lighting as safe and handy as electric lighting." We are well aware of the unique convenience, safety, and handiness of the electric light, but it is seldom that a concern interested in the sale of gas appliances so freely admits its excellences. With regard to the gas switch, we have nothing to say, though we suspect that it is electrically operated—for the machinery with which it will be made is stated to be suitable also for the manufacture of dynamos!—but we sympathise with the users of it, who, whilst enjoying the convenience of electric lighting, will nevertheless continue to "enjoy" the discomforts of gas lighting.

D

TARIFFS FOR ELECTRICITY SUPPLY.

By HENRY M. SAYERS.

Of the making of tariffs there is no end. There are literally hundreds of different tariffs for the supply of electrical energy in operation to-day. Some undertakers offer a bewildering choice, due to the endeavour to meet the conditions of various classes of consumers; no one would-be consumer is likely to look at more than two or three of them.

It is generally recognised that the greatest field for the extension of electricity supply is the domestic field, and the bulk of that is necessarily in the homes of the people of small incomes and little or no capital. These are the very people who are most oppressed by the drudgeries which electrical services can do so much to relieve. It is not necessary to labour this point.

On the other side—that of the supply undertakings—it is equally clear, and is generally recognised, that the capital invested in their business is not utilised to nearly its full capacity. The generating stations which have a load factor as high as 25 per cent. are in the minority. Evidently anything in the way of additional output which increases this load factor, increases the utilisation of the capital employed, and diminishes the incidence of capital charges upon the price per unit. That is, for an increased load factor, lower prices can be charged, while the necessary return upon capital to cover depreciation and profits is fully maintained. Further, lower prices encourage and stimulate consumption, so that both gross and net receipts increase. This has been abundantly proved by past experience in the electricity supply industry itself, as well as in nearly every other which satisfies human necessities and desires.

It may be pointed out here that the customary mode of expressing load factor as a percentage is somewhat misleading. An increase of a few units in this percentage looks small. The increase, say, from 20 to 25 per cent. strikes one at first sight as only a 5 per cent. increase. It is really an increase of 25 per cent. in the output and earning capacity. It is an increase of 25 per cent. in the bulk of the product over which capital and overhead charges can be spread.

In electricity supply this is no small matter. One finds that in this country the working expenses of electricity supply are about half the gross receipts, and the load factor is in the neighbourhood of 20 per cent. Assuming that the other half of the gross receipts must be maintained to cover capital charges and profits, and assuming also that working expenses per unit will not vary with an increased output due to higher load factor, with an improvement of a load factor to 25 per cent. from 20 per cent., the capital charges now required on four units sold could be spread over five units, and the prices and gross receipts per unit could be lowered by 10 per cent., with no sacrifice in the net revenue needed to meet the capital charges.

The assumption that working expenses will not vary with better load factor is an unfavourable one. It is common experience that working expenses tend to fall with higher load factor, and this for a very simple reason. Quite a large part of the expenditure on fuel—the biggest item in working expenses—is conditioned not by the output, but by the maximum load which has to be prepared for. It costs just as much fuel to raise steam in boilers for a twelve-hours' run as for a two-hours' run, and there are a number of items of smaller importance in the working expenses of generating stations of which the same thing can be said. It is quite common to find that these "stand-by" or making-ready costs run up to 20 or 30 per cent. of the working costs.

It is easier to see the meaning of load factor if it is expressed as the number of hours' use of the maximum load equivalent to the output in a given period. As there are 8,760 hours in a year, and the year is the common accounting period, a 20 per cent. load factor is 1,752 hours' use in the year of the maximum load, or an average of 4.8 hours' use per day of the maximum load; a 25 per cent. load factor is six hours' average daily use, or 2,190 hours' annual use.

All this is an old story; it was preached by Hopkinson many years ago; its lessons were put into practice by Wright, followed by many other engineers, and are embodied in scores of tariffs which more or less correctly take account of the maximum demand and load factor of individual consumers or classes of consumers.

Experience has shown, however, that a maximum demand tariff is not an acceptable one to the average small consumer, especially not to the domestic consumer. He feels, first, that he is unduly penalised for what may be a very infrequent maximum demand; secondly, that there is an element of paying something for nothing, or for very little; and the uncertainty as to what the supply is actually costing him is distasteful. The small domestic consumer undoubtedly prefers a flat rate. The undertaker has also some objections. Additional apparatus in the form of demand indicators has to be provided and maintained, two meter readings instead of only one have to be taken, and the working out of invoices is more complex. These considerations do not apply to large consumers, especially industrial consumers, who can appreciate the logic and the advantage of the system, and whose consumptions are so large that the additional apparatus and account work are of negligible importance.

The writer has been from the first a convinced adherent of the maximum-demand principle, or rather the Hopkinson principle of electricity supply charges; he has put it into use with good results in various places, but he has had to recognise that with the domestic consumer generally it is unpopular, and somewhat troublesome and expensive for the undertaker to apply to such consumers.

It must be remarked that at the time at which Hopkinson preached, and Wright and others put into practice, the maximum-demand charge principle, there was only the one application of lighting which mattered. As the lighting loads of various consumers in a given area were nearly simultaneous, or, at any rate, continuous over certain evening hours, it was a simple and rational procedure to reckon on the cost of the maximum demand at a uniform rate. It was known that this uniform rate was not strictly equitable—that a consumer whose maximum load occurred off the peak should logically be charged less than those whose maxima drove up the peak—but it was not easy to apply this knowledge.

To descend from generalities, the problem to-day is to supply the small domestic consumer at a tariff which will attract the business, and which will be remunerative to the supplier.

It is probably correct to say that small house lighting, by itself, cannot be supplied profitably at a flat rate which will attract business, or which can be legally applied. The supplier has to cover overhead charges on mains, services, meters, and other things, which leave little or no return on the small lighting consumptions at any practicable price. But if to the small lighting consumption is added the much larger consumption for cooking, heating water, and sundry other purposes, then a small overall rate per unit will provide a satisfactory return. It is obvious that these other uses, by their diverse time incidence, have the effect of improving the general load factor, which in itself permits of lower prices.

A great many tariffs are in operation which aim at ensuring the supplier against loss by some form of

initial charge designed to cover the overhead costs. That done, the price per unit consumed can be made low enough to attract many consumers. One need only mention the rateable value basis, the floor area basis, and the so-called "telephone" basis as examples. All these are really applications of the maximum-demand system. So far as they have a rational basis, that must be a calculation that on the average the fixed element in these double-rate tariffs will meet the cost of the consumer's maximum demand and other fixed or overhead charges incidental to supplying him. It may be assumed that usually these calculations have been made with fair correctness, having some natural bias on the safe side, and they have met with a considerable amount of success. Possibly one or more of them, if pressed with enthusiasm and intelligence, would be generally effective.

But there are some criticisms of these two-part tariffs which consumers are likely to make. At first sight the rateable value, or the floor area of premises, seems somewhat irrelevant to the proper charge to be made to the occupier for a supply of electricity. It is obvious that if applied to premises varying much in magnitude and use, it would lead to indefensible anomalies. It will no doubt be said that in practice the class of consumers to whom such tariffs are offered, and to whom they appeal, are on very equal conditions. This may be so at present, but in the application to a much larger body of the smaller occupiers difficulties are likely to increase.

There is also the consumer's objection to the simple maximum-demand system, mentioned above, that such tariffs seem to contain an element of paying something for nothing. The man with small earnings hates engaging himself to pay fixed periodical sums; he has to do it for rent and a few other things, but, so far as possible, he wants to be able to adapt his week's expenditure to his week's earnings. Hence the appeal and popularity of the slot gas meter with the wage-earning classes.

In the application of the maximum-demand system, the charge per kW should equitably take into account the diversity factor prevailing among the consumers to whom it is applied. Taking any particular class of consumers, it will be found that the aggregate maximum load is less than the total of the individual maxima. Taking all the consumers of an undertaking, the ratio of total individual maxima to aggregate maximum load is quite likely to be of the order of 2 or 3. It is a difficult figure to obtain, for it can only be accurately ascertained by fitting and reading maximum load indicators for every consumer, which, so far as the writer knows, is not practised by any British undertaking. A study of load diagrams for different days, with a knowledge of local habits and conditions, permits of some estimate of the diversity factor. The fact that "connected load" is generally from three to six times the maximum load suggests that diversity factor among consumers has a higher value than is generally supposed. Works and factories probably have a lower diversity factor than some other loads.

In the case of small domestic supplies, where cookers, &c., form the bulk of the connected load, the diversity factor is likely to be very high. Mr. Gillott, in his I.E.E. paper on "Domestic Load Building," showed that in 25 houses on the Billingham housing estate, with a total connected load of 282 kW, the maximum demand over one week in December only reached 31 kW, and that on a Sunday during the dinner-cooking hour. The average maximum for the week was only 24 kW. The average connected load at each house was 11.28 kW. It was further shown by the load diagrams that the cooking and heating load occurred during the daylight hours; the evening showed only the lighting load. The diversity factor appears to have been about 9.

A test on so small a number of houses is open to the objection that this may not be a good sample case; but it may be noted that the occupants were very much of one class, and of one set of habits, facts which tend to lessen the diversity factor of the group, and are therefore unfavourable. Nevertheless, the diversity factor is clearly a high one.

Again, at Hackney, Mr. Robinson has shown by load curves that a large connected load of cookers does not much increase the maximum load, and this is borne out by a number of other experiences. It seems, therefore, quite safe to calculate on a very high diversity factor among consumers of the class under consideration, and a similarly large ratio between total connected load and total maximum load.

It is nothing new that in a wage-earning group the maximum cooking load occurs just before the Sunday dinner hour. It is only a corroboration of the experience of gas companies which hire out cookers in such districts. It is known that some of these companies get their weekly peak loads on Sunday mornings, a time at which the average electric generating station has a very small load.

From these experiences it appears that one can safely estimate that the diversity factor among consumers of this class is so great that a proper kW demand charge will be but a small fraction, perhaps from one-tenth to one-fifth of the capital and other standing charges per kW of station maximum load.

The suggestion arising from a consideration of these facts is that it is possible to embody the maximum-demand principle in a flat-rate tariff. To do this it would be necessary to classify domestic consumers, giving to each class a diversity factor value based on experience and probability. The average maximum load of each consumer in a given class might be taken as the load of the largest consuming appliance connected, but this maximum load divided by the appropriate diversity factor would be the proper proportion of station maximum load to be debited. The annual or quarterly consumption of the consumer could be estimated conservatively, and a flat rate fixed which would give the necessary capital charges, plus working costs, &c.

In this way the advantage and simplicity of the flat rate would be retained, and this flat rate be low enough to suit the consumer and high enough to ensure the supplier a proper return. Evidently prepayment meters could be used.

It might suffice to base the maximum-demand term upon the lighting only. Mr. Gillott's paper suggests that this is enough, and there are many tariffs in operation which do it in some way or other. But the writer is inclined to think that this plan, really based on the assumption that the lighting load will always produce the system peak load, may not in course of time prove to be well founded. Already stations supplying considerable industrial loads get a great many days per annum with peak loads during the daytime. It must be admitted that from the middle of November until the middle of February, even these stations usually get their peaks in the evening, but this is largely due to factory lighting and power load coinciding. The peak drops as the works shut, and the domestic lighting-up as people go home does not make up for the drop.

It may well be that before long the lighting load will not form the summit of the peak, but only decrease the downward slope after working hours.

However, this may be left to experience, and no doubt in most places the lighting load does determine the maximum load of the year at present.

There will naturally be some hard thinking necessary to settle the basis and the details of the classification of consumers for the application of different flat rates, but it does not seem likely that more than two or three classes need be defined in any one area. The logical basis of classification seems to be the composition of the connected load. Cooker and lighting; cooker, washboiler, and lighting; or cooker, cumulative water-heater, and lighting; and the kW capacity of each load, would each justify a different classification for example.

It hardly need be said that the use of radiators or

other space heating appliances would need a quite different load demand coefficient from cookers. And it is probable that these domestic flat-rate consumers would be found almost entirely among the occupiers of relatively small houses. A maximum rental limitation might be desirable, but this would vary in different places. In London, for example, the system seems suitable for some of the smaller flats with a very different rental scale from small houses.

It may be thought that different flat rates based on a classification of the kind suggested are inconsistent with the provisions of the Acts against preferential charging. This is open to argument, but if difference of circumstances can be established, then different rates are legal. Contracts at any rates are legal.

The Electricity (Supply) Act of 1922 enables undertakers to apply for sanction to other methods of charge than those now in force, and repeals the consumer's right to require to be charged by a flat rate. The last-named provision is perhaps not of much importance in respect of tariffs for the class of consumer under consideration, but it may assist undertakers to get some lighting consumers (especially small offices and similar places) on a better revenue-earning basis. It is rather remarkable that undertakers have not shown much disposition yet to ask for sanction to new methods of charging. Perhaps they are trying out their many tariffs before they venture.

The question of tariffs for the small domestic supply is not the only matter of difficulty. The cost of installation, especially of such items as cookers, is a rather serious one. As regards the cost, that, no doubt, will go down. If it is true that there are only 5,000 cookers in use in this country, and that the manufacturing capacity for these articles is only about 5,000 per annum, it seems that there is room for the application of Mr. Henry Ford's business methods to electric cookers. Those who have read Mr. Ford's entertaining story of his business life will know what these methods are, and those who have not read it had better do so at once. They will be instructed as well as interested. Besides the price, which at present makes it impossible for many small householders to purchase outright, there are legal obstacles to local authority undertakers generally supplying these things on acceptable terms. Some few have powers; it is unfortunate for both the industry and the public that the hands of the majority are tied. It is particularly unfortunate that the objection to giving the local authority undertakers freedom to conduct their business on business lines comes from a section of the electrical industry itself. It is surely a short-sighted policy.

Some company undertakers have done well in the supply of cookers and so forth on easy terms, some seem apathetic, perhaps they feel the cold shade of the Upas of compulsory purchase in advance. The general fear of overloaded mains expressed rather freely not so long ago is certainly yielding to experience, but there may yet be places where there is some ground for it.

However, these considerations lead one away from tariffs. The points which the writer has tried to make here are:—

1. Supply undertakings generally have but a poor load factor, and consequently relatively heavy overhead charges, reflected in their prices.

2. There is business available, which would greatly improve the load factor, reduce the overhead charges per unit sold, and benefit the undertakers and others by increased demand and consumption. This business would justify reduced prices; it cannot be got without them.

3. The business suggested is that of supply to the smaller class of houses, mainly occupied by wage earners, and must include cooking and other drudgery-reducing, hygienic, and economising applications.

4. To get this business, attractive tariffs are necessary. If possible, these should be simple flat rates, but the rates must embody the Hopkinson principle to protect the supply undertakers. It is suggested that this can be done by classified flat rates, "loading" each class with a proper maximum-demand term, derived from the collective maximum demand and diversity factor of each class, as calculated, corrected by experience.

5. So far as it may appear that there are legal difficulties in applying such tariffs, it is suggested that the Electricity (Supply) Act of 1922 provides a way out.

6. The business suggested requires not only attractive tariffs, but the supply on easy terms of the installations and appliances; and lower prices for the latter, due to mass production, or "Henry Ford" principles of manufacture and gas-company principles of supply; but this point is not followed out in detail.

THE DEFORMATION OF TRAVELLING ELECTRIC WAVES.

By S. AUSTEN STIGANT, A.M.I.E.E., M.Amer.I.E.E.

Transient electric waves in a power circuit are generally a source of danger on account of their amplitude, but more particularly on account of the steepness of the fronts of the waves. These disturbing transient waves may arise as a result of switching operations, arcing grounds, and atmospheric lightning discharges, and the waves may be considered to be finite or infinite in length according to whether the wave propagation takes the form of a single impulse or a train of high-frequency waves. In order to minimise the effects of these transients, various forms of lightning-arrester gear have been produced, most of which embody the characteristics of inductance and capacity. In some of these devices these characteristics very largely predominate, and it is a matter of some interest to show exactly what effects inductance and capacity have in deforming the initial shapes of transient waves. For this purpose two circuits of the same surge impedance will be considered, a series choke coil being inserted at the junction between the two circuits in the one case, and a condenser being shunted from the junction of the two circuits to earth in the other.

Fig. 1 shows step by step how finite rectangular pressure and current waves are deformed by a series choke coil when passing from one circuit to another of the same surge impedance past the coil. The formulæ for constructing the shapes of the waves are given in the figure. An explanation of the diagrams shown in fig. 1 is as follows:—

Diagram 1*a* shows a rectangular finite pressure wave and 1*b* a rectangular finite current wave which have been set up in circuit Z_1, approaching the choke coil.

Diagrams 2*a* and 2*b* show the same waves at the moment they reach the choke coil. At the very same instant the coil acts as an open circuit to the front of the incident travelling waves so that these portions of the waves are reflected back along circuit Z_1 with the same sign for the pressure wave and with opposite sign for the current wave. At the first instant, therefore, this reflection can only be indicated by vertical lines as shown, and the resultant pressure, at the transition point only, is doubled, while the current is zero. At this particular stage the phenomena are exactly the same as if circuit Z_1 were open-circuited at the transition point. The choke coil is, therefore, exerting its maximum back e.m.f., which is equal in amplitude to

the pressure of the incident wave, so that at this instant no current can flow into circuit Z_2.

Diagrams 3*a* and 3*b* show the phenomena at a short period of time when the incident waves have progressed a little further towards the transition point. The period of time which is assumed to have elapsed between these figures and figs. 2*a* and 2*b* is such as allows the back e.m.f. of the choke coil to fall by a certain amount i_c. This allows the penetration of a corresponding amount of current i_c into circuit Z_2, this current producing the first part of the transmitted pressure wave front. The effect of the choke coil on the reflected pressure and current-wave fronts is to act as a discharge from front to back, which, of course, is simply the result of the decreasing back e.m.f. of the choke coil with the consequent transmission of current to circuit Z_2. The current waves representing the choke-coil charge are the same in both circuits Z_1 and Z_2 (and would be so whatever the ratio of Z_1 to Z_2), but in the case of the reflected current wave, the current *always* commences at a negative value equal to the positive amplitude of the incident wave, while the transmitted current wave commences from zero. The reflected current wave subtracted from the remainder of the incident current wave gives the *resultant* current distribution, and it will be seen that the front of the *resultant* reflected current wave is positive at this instant, and that it is split up into two portions, one being rectangular and the other having the same slope as the transmitted wave.

The pressure waves of the choke-coil charge are, when $Z_1=Z_2$, the same in both circuits (though they would be different for a non-equality of Z_1 and Z_2), but in the case of the reflected wave the charge always commences at a positive value equal to the positive amplitude of the incident pressure wave, while the transmitted wave commences from zero. The reflected pressure wave added to the remainder of the incident pressure wave gives the resultant pressure distribution, and the front of the resultant reflected pressure wave is still positive, but equal in amplitude to double the incident wave, though the wave has a drooping characteristic which is the same as the rising characteristic of the transmitted pressure wave. The backs of the incident waves remain unchanged.

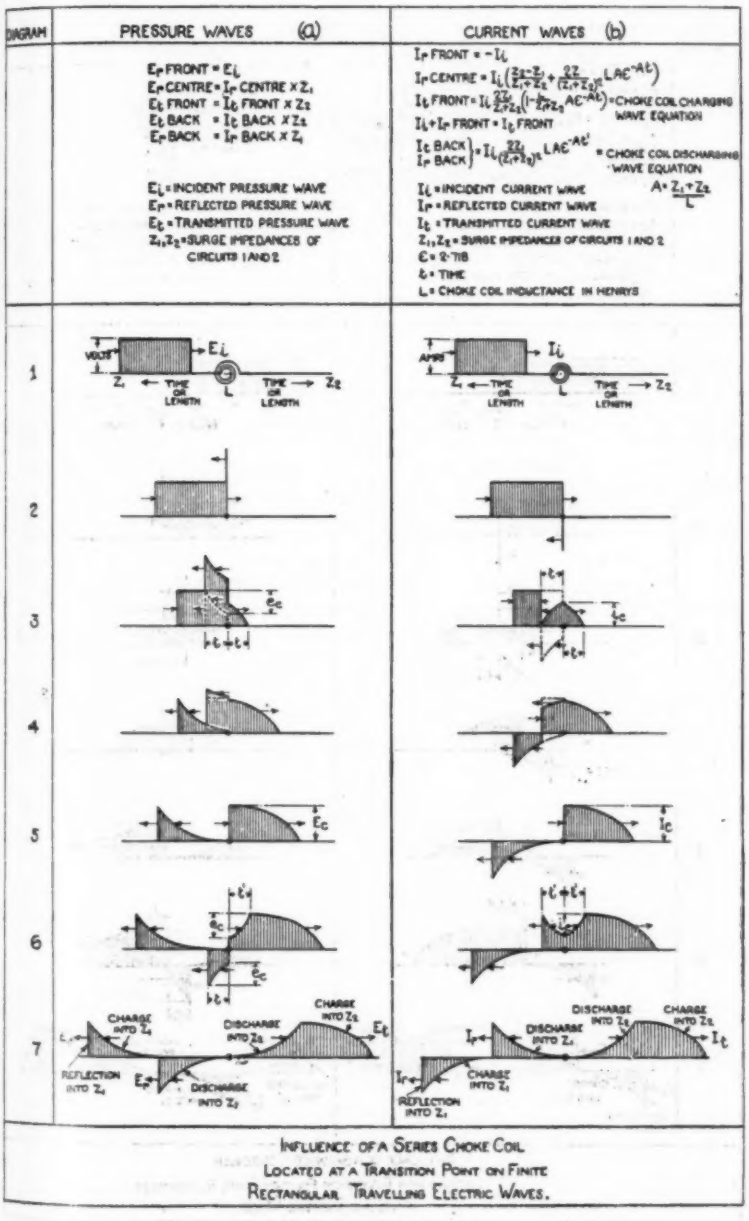


DIAGRAM
PRESSURE WAVES (a)
CURRENT WAVES (b)
E_F FRONT = E_I
E_F CENTRE = I_F CENTRE × Z_1
E_t FRONT = I_t FRONT × Z_2
E_t BACK = I_t BACK × Z_2
E_F BACK = I_F BACK × Z_1
E_I = INCIDENT PRESSURE WAVE
E_F = REFLECTED PRESSURE WAVE
E_t = TRANSMITTED PRESSURE WAVE
Z_1, Z_2 = SURGE IMPEDANCES OF CIRCUITS 1 AND 2
I_F FRONT = $-I_I$
I_F CENTRE = $I_I\left(\frac{Z_2-Z_1}{Z_1+Z_2}+\frac{2Z}{(Z_1+Z_2)^2}LAe^{-At}\right)$
I_t FRONT = $I_I\frac{2Z_1}{Z_1+Z_2}\left(1-\frac{Z_2}{Z_1+Z_2}Ae^{-At}\right)$ = CHOKE COIL CHARGING WAVE EQUATION
I_t FRONT + I_F FRONT = I_t BACK
I_t BACK / I_F BACK = $I_I\frac{2Z_1}{(Z_1+Z_2)^2}LAe^{-At}$ = CHOKE COIL DISCHARGING WAVE EQUATION
$A=\frac{Z_1+Z_2}{L}$
I_I = INCIDENT CURRENT WAVE
I_F = REFLECTED CURRENT WAVE
I_t = TRANSMITTED CURRENT WAVE
Z_1, Z_2 = SURGE IMPEDANCES OF CIRCUITS 1 AND 2
e = 2·718
t = TIME
L = CHOKE COIL INDUCTANCE IN HENRYS
VOLTS
AMPS
TIME OR LENGTH
CHARGE INTO Z_1
DISCHARGE INTO Z_2
CHARGE INTO Z_2
DISCHARGE INTO Z_1
REFLECTION INTO Z_1
DISCHARGE INTO Z_2
CHARGE INTO Z_1
REFLECTION INTO Z_1

INFLUENCE OF A SERIES CHOKE COIL LOCATED AT A TRANSITION POINT ON FINITE RECTANGULAR TRAVELLING ELECTRIC WAVES.

FIG. 1.

Diagrams 4*a* and 4*b* show the conditions after the elapse of a further period of time. In this case the back e.m.f. of the choke coil has further decreased, so that the transmitted waves have increased in length and amplitude, while the reflected waves have also increased in length, but the amplitude of the backs of the waves have correspondingly been reduced. In this case the lengths of the reflected waves from the transition point are greater than the remaining lengths of the original incident waves, so that the backs of the incident waves are now modified. In the case of the current wave, the amplitude of the back of the original incident wave is reduced, while that of the pressure wave is increased. As in the case of diagram 3, the resultant pressure- and current-wave distribution is obtained by addition and subtraction of the reflected and incident waves.

Diagrams 5*a* and 5*b* show the case where the backs of the original incident waves have just reached and are about to pass the transition point, the choke coil back e.m.f. having become zero. It will be noticed that the current and pressure through the choke coil are at their maximum values and equal to those of the original rectangular incident waves. The transmitted waves are positive, and it will be seen to what extent the fronts have been smoothed down as compared to the rectangular shape that they would have had if the choke coil had not been present. The backs of the transmitted waves are at this instant rectangular. The reflected waves are, neglecting sign and position, complementary in shape and area to the transmitted waves having rectangular fronts and tapering backs. At th transition point their values are zero.

At the instant following that shown in diagram 5, the choke coil begins to discharge back into both circuits, and diagrams 6*a* and 6*b* show the conditions after a further short period of time. The transmitted waves pass still further along circuit Z_2 without any change in the shape of front (apart from that due to energy dissipation), while the backs now become sloping instead of rectangular. This is due to the drop in

pressure e_s occurring during the time t' consequent upon the discharge of the coil. As the coil discharges into both circuits Z_1 and Z_2, further reflected pressure and current waves are produced, with negative and positive signs respectively. These are not true reflected waves, but simply discharge waves from the choke coil. The waves have rectangular fronts and sloping backs which correspond exactly with the backs of the transmitted waves. The original reflected waves remain unchanged from the previous diagrams. The current through the coil has dropped from I_c to $I_c - i_c$.

Diagrams 7*a* and 7*b* show the final wave shapes when the choke coil has completely discharged, that is, when both the pressure and current at the transition point are zero. These figures are similar to the immediately preceding ones, the only difference being that the waves have progressed further along the circuits Z_1 and Z_2 in their respective directions, and that the terminal portions of the backs of the transmitted and reflected waves are more sloping still.

It may be pointed out that all the wave forms in the above diagrams are simply the characteristic curves of choke-coil charge and discharge. In diagrams 3 and 4 it is only necessary to subtract the reflected current waves from those portions of the original incident waves which remain to obtain the wave forms on the left of the transition point; the reflected pressure waves in the same diagrams are added to the portions of the original incident pressure waves which remain, to obtain the wave forms on the left of the transition point. It is also worthy of note that choke-coil protection alone only modifies the shape of the backs and fronts of the transmitted waves and the backs of the reflected waves. It does not modify the fronts of the reflected waves, and this aspect may not necessarily be important, particularly as the amplitudes of such fronts only exert their influence at each point of the circuit for an instant. Choke-coil protection does, however, very considerably reduce the pressure gradient at the front of the transmitted waves, and this is usually by far the most important feature.

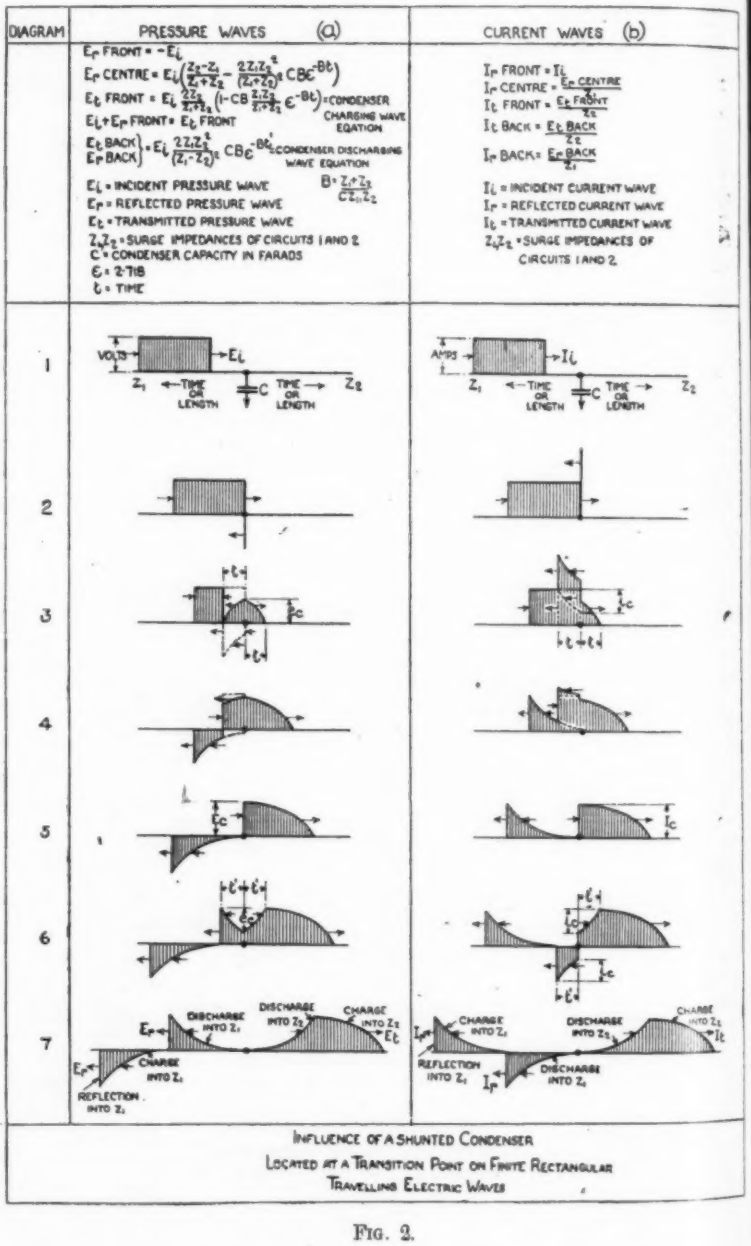
It should be borne in mind that all the foregoing remarks aply to the case where the surge impedances of the circuits on either side of the transition point are equal. In all cases, quite irrespective of equality of surge impedances, the equations for both the reflected and transmitted current waves are the same, the only difference being that the charging front of the former starts at a negative maximum, while the latter commences from zero. Both reflected and transmitted current discharge waves are identical in every respect. The pressure waves are in every case dependent upon the reflected and transmitted current waves and surge impedances of the respective circuits.

Fig. 2 shows how the same finite rectangular pressure and current waves are deformed when passing from one circuit to another of the same surge impedance, but past a shunted condenser. The formulæ for calculating the wave shapes are again given in the figure, the diagrams of which may be explained as follows:—

Diagram 1*a* shows a rectangular finite pressure wave and 1*b* a rectangular finite current wave which have been set up in circuit Z_1, approaching the condenser.

Diagrams 2*a* and 2*b* show the same waves at the moment they reach the condenser. At the very first instant the condenser acts as a short circuit to the front of the incident travelling waves, so that these portions of the waves are reflected back along circuit Z_1, with opposite sign for the pressure wave and the same sign for the current wave. At the first instant, therefore, this reflection can only be indicated by vertical lines as shown, and the resultant pressure, at the transition point only, is zero, while the current is doubled. At this particular stage the phenomena are exactly the same as if circuit Z_1 was short-circuited at the transition point. The condenser is, therefore, just about to become charged.

Diagrams 3*a* and 3*b* show the phenomena at a short period of time later when the incident waves have progressed a little further towards the transition point. The period of time which is assumed to have elapsed between these diagrams and diagrams 2*a* and 2*b* is such as allows the shunt condenser to charge up from



INFLUENCE OF A SHUNTED CONDENSER LOCATED AT A TRANSITION POINT ON FINITE RECTANGULAR TRAVELLING ELECTRIC WAVES

FIG. 2.

zero to a certain pressure e_c. This allows the pressure wave, reckoned from zero to e_c for the time t, to be transmitted into circuit Z_2, and it will be noticed that the characteristics of the condenser result in producing much flatter transmitted pressure and current waves. The effect of the condenser on the reflected pressure and current wave fronts is to act as a discharge from front to back. The pressure waves representing the condenser charge are the same in both circuits Z_1 and Z_2 (and would be so whatever the ratio of Z_1 to Z_2), but in the case of the reflected pressure wave the charge *always* commences at a negative value equal to the positive amplitude of the incident wave, while the transmitted pressure wave commences from zero. The reflected pressure wave subtracted from the remainder of the incident pressure wave gives the resultant pressure distribution, and it will be seen that the front of the *resultant* reflected pressure wave is positive at this instant, and that it is split up into two portions, one being rectangular and the other having the same slope as the transmitted wave.

The current waves of the condenser charge are, when $Z_1=Z_2$, the same in both circuits (though they would be different for a non-equality of Z_1 and Z_2), but in the case of the reflected wave the charge always commences at a positive value equal to the positive amplitude of the incident current wave, while the transmitted wave commences from zero.

The reflected current wave added to the remainder of the incident current wave gives the resultant current distribution, and the front of the resultant reflected current wave is still positive, but equal in amplitude to double the incident wave, though the wave has a drooping characteristic, which is the same as the rising characteristic of the transmitted current wave. The backs of the incident waves remain unchanged.

Diagrams 4*a* and 4*b* show the conditions after the lapse of a further period of time. In this case the charge across the condenser has increased so that the transmitted waves have increased in length and amplitude, while the reflected waves have also increased in length, but the amplitudes of the backs of the waves have correspondingly been reduced. In this case the lengths of the reflected waves from the transition point are greater than the remaining lengths of the original incident waves, so that the backs of the incident waves are now modified. In the case of the pressure wave, the amplitude of the back of the original incident wave is reduced, while that of the current wave is increased. As in diagram 3, the resultant pressure and current wave distribution is obtained by subtraction and addition of the reflected and incident waves.

Diagrams 5*a* and 5*b* show the case where the backs of the original incident waves have just reached, and are about to pass, the transition point, the condenser having become fully charged. It will be noticed that the pressure across and the current through the condenser are at their maximum charging values and equal to the original rectangular incident waves. The transmitted waves are positive, and it will be seen to what extent the fronts have been smoothed down as compared to the rectangular shape they would have had if the condenser had not been present. The backs of the transmitted waves are at this instant rectangular. The reflected waves are, neglecting sign and position, complementary in shape and area to the transmitted waves, having rectangular fronts and tapering backs. At the transition point their values are zero.

At the instant following that shown in diagram 5, the condenser begins to discharge back into both circuits, and diagrams 6*a* and 6*b* show the conditions after a further short period of time. The transmitted waves pass still further along circuit Z_2 without any change in the shape of front (apart from that due to energy dissipation), while the backs now become sloping instead of rectangular. This is due to the drop in pressure occurring during the time t' consequent upon the discharge of the condenser. As the condenser discharges into both circuits, Z_1 and Z_2, further reflected pressure and current waves are produced with positive and negative signs respectively. These are not true reflected waves, but are simply discharge waves from the condenser. The waves have rectangular fronts and sloping backs which correspond exactly with the backs of the transmitted waves. The original reflected waves remain unchanged from the previous diagrams. The pressure across the condenser has dropped from E_c to $E_c - e_c$.

Diagrams 7*a* and 7*b* show the final wave shapes when the condenser has completely discharged, that is, when both the pressure and current at the transition point are zero. These figures are similar to the immediately preceding ones, the only difference being that the waves have progressed further along the circuits Z_1 and Z_2 in their respective directions, and that the terminal portions of the backs of the transmitted and reflected waves are more sloping still.

It may be pointed out that all the wave forms in the above diagrams are simply characteristic curves of condenser charge and discharge. In diagrams 3 and 4 it is only necessary to subtract the reflected pressure waves from those portions of the original incident waves which remain to obtain the wave forms on the left of the transition point; the reflected-current waves in the same diagrams are added to the portions of the original incident current waves which remain to obtain the wave forms on the left of the transition point. It is also worthy of note that condenser protection alone only modifies the shape of the backs and fronts of the transmitted waves and the backs of the reflected waves. It does not modify the fronts of the reflected waves. Condenser protection does, however, very considerably reduce the pressure gradient at the front of the transmitted waves, and this is usually by far the most important feature.

It should be borne in mind that all the foregoing remarks apply to the case where the surge impedances of the circuits on either side of the transition point are equal. In all cases, quite irrespective of equality of surge impedances, the equations for both the reflected and transmitted pressure waves are the same, the only difference being that the charging front of the former starts at a negative maximum, while the latter commences from zero. Both reflected and transmitted pressure discharge waves are identical in every respect. The current waves are in every case dependent upon the reflected and transmitted pressure waves and the surge impedances of the respective circuits.

The shape and sign of the transmitted pressure and current waves are exactly the same for choke-coil and condenser protection, but the reflected wave phenomena are opposite in the two cases. That is, the reflection pressure waves for choke-coil protection are the same in shape and sign as the reflection current waves for condenser protection, while the reflection choke-coil current waves are the same in shape and sign as the reflection condenser pressure waves.

The equation connecting choke-coil inductance and condenser capacity for the same degree of protection, that is, for the same amplitude and gradients of transmitted waves, is $L=Z_1.Z_2.C$ where L and C are the inductance and capacity of the protective devices in henrys and farads respectively.

The above notes have been written solely with the idea of showing that when choke-coil and condenser protective devices are used, the transmitted waves are functions of the charge and discharge phenomena of these devices, and the diagrams and formulæ show how the waves may be calculated. When the circuit to be protected consists of a coiled inductive winding, the transmitted wave fronts become stepped on account of the local capacity and mutual inductive effects of adjacent turns of the windings. The mean shapes of the waves are, however, closely similar to those shown.

The subject has been dealt with more fully by the writer in a paper read before the Junior Institution of Engineers,* to which those interested in the matter are referred.

* "The Influence of Condenser and Choke-coil Protective Devices on Travelling Electric Waves." *Journal*, J.I.E., June, 1923.

THE "NEVER-STOP" RAILWAY.

(By a Special Correspondent.)

Some 12 years ago Mr. W. Yorath Lewis made public by reading papers before the Royal Society of Arts, the British Association, and other bodies, a system of continuous passenger transport which he had invented and designed to the extent of installing a small-scale model at Ipswich. The outbreak of war in 1914 prevented the execution of a sample installation on the Aldwych island site which had been arranged for, and it is only this summer that a line has been built and put into operation at the Kursaal, Southend.

On Saturday last, September 15th, by invitation of the directors of Never-Stop Transit, Ltd., a large party of engineers, representatives of municipalities, and the Press inspected this line, had its operation and design explained in detail, and heard a speech from Capt. H. Riall Sankey setting out the general features and the advantages claimed over other methods of passenger transport of large capacity.

The main feature of the "Never-Stop" Railway is that a screw thread attached to a revolving shaft lying between and parallel with the rails, engages an attachment to a truck of each car, and thereby propels the car along the rails at a speed depending upon the revolving speed of the shaft and the pitch of the thread. The attachment on the truck is, in effect, a very small portion of a single thread of a nut, and the car is propelled just as a nut, which is prevented from revolving, is propelled along a screw which revolves and is restrained from moving lengthwise. The "nut" is a pair of rollers mounted on vertical axes, between which rollers the thread passes, and possesses no pitch of its own. The pitch of the thread is varied from a minimum at the stations to a maximum between them, the minimum pitch corresponding to a car speed of about three miles per hour, at which the cars can be readily entered or left. The maximum pitch corresponds to about 24 miles per hour. Deceleration and acceleration of the car approaching and leaving a station are obtained by a gradual alteration of the pitch of the thread. During acceleration and on a rising grade the thread bears against what may be called the "leading" roller, and during deceleration and on a falling grade the "trailing" roller bears against the thread, tending to drive it. Hence, there is a simple and direct regenerative control effect, dispensing with braking of any kind.

It is very curious to watch a station with the cars crowding up on the approach side into an almost continuous train, and separating and stringing out along the line on the leaving side. The result is that there is no waiting for a car, the service is almost as continuous as with a moving platform, yet the line is not solid with cars.

To come to details, the propelling screw presents most interest. This is made in lengths of about 34 ft. The shaft is a steel tube of 12-in. diameter, to which are welded spokes or arms in spiral order; the thread is a bar of flat steel drilled for the passage of the screwed outer ends of the spokes and secured to them by nuts. The diameter of the thread is about 24 in. Contiguous lengths are connected by journals carried in roller-bearing housings, the attachment between the tubular shaft and the journals being made by a coupling which includes a corrugated diaphragm, allowing for expansion and giving a certain amount of flexibility to the coupling. The continuity of the thread across the bearings is secured in a most ingenious manner. The two ends of the bars of the neighbouring shafts are joggled, one to a slightly larger radius, the other to a slightly smaller radius than the general thread radius, and they overlap a little in the longitudinal direction. The pedestal of the bearing in radial longitudinal section is zigzag with grooves on the one side and the other corresponding to the radial positions of the over hanging ends of the thread bars. This is simple enough to look at and describe, but it has the simplicity of genius, and is probably the result of a great expenditure of thought and scheming. The shaft runs at about 300 r.p.m.

On curved track the screw lengths are necessarily chords to the arcs, and meet at angles. Here, each length has its own journal and bearing, and the inner ends of the two journals connect by a pair of crown wheels. This arrangement serves for curvature in either horizontal or vertical planes. The Southend line has curves of 300 ft. radius and gradients up to 1 in 20. The two tracks are connected at the ends of the line by semi-circular loops of 3-ft. radius. The transit of the cars round these semi-circles is effected by an arm revolving on a vertical spindle at the centre of the curve, which catches the engaging rollers of a car as they come clear of the end of the thread, pushes the car round the semi-circle, and leaves the rollers as the thread-bar of the opposite track engages them. This arm is geared to both shafts, so that the timing of the arm and the two threads is positively fixed.

It occurred to the writer that there must be a material end thrust to be taken by the shaft bearings. Inspection of the drawings and inquiry of Mr. Lewis himself showed that the bearings are ball bearings of ordinary type, *i.e.*, they are not special thrust bearings. As they are of 6 in. (or over) diameter, presumably the end thrust is not in excess of that which such ball bearings can carry. The end thrust in any given case, depending upon the car weight, acceleration, and gradient, is readily calculable, and it does not appear that there should be any difficulty in providing for it. It amounts to about 1,500 lb. at maximum acceleration of a 2½-ton car.

The two shafts—one for each track—each about 300 yards in length, are driven by two continuous-current motors, one at each end of the line. As above noted, the two shafts are geared together at the ends, so that the 600 yards form a single mechanically-coupled system. This coupling of the shafts obviously balances out the effects of gradients, acceleration, and deceleration, excepting for frictional losses. One result is that the load on the motor or motors driving each section is a steady one, assuming the cars to be equally spaced and loaded.

It is suggested by the company that on a real line there should be a driving motor to every 400 yards of route. There is no example of an intermediate drive on the Southend line, so one cannot say how it is designed to get over the apparently inevitable break in the driving thread at such points; probably a simple adaptation of the transfer arm, as described above at the terminal loops, will meet this.

The track is made up of two running rails with flat tables, rolled joists in fact, with the webs vertical, and two channel irons with the webs horizontal, laid inside the running rails. The inner flanges of these channel irons are the guides which keep the cars to the track. Each truck carries four guiding wheels, which run in the groove formed by the guides. The running wheels have no flanges. Both the running wheels and the guide wheels are rubber tired. Obviously the propelling screw produces a lateral thrust as well as a forward thrust, which would have to be taken by the flanges of running wheels and the corresponding rail on one side only, and the provision of guide wheels near the centre line to take this thrust instead of wheel flanges seems a sensible improvement.

The cars are carried on two trucks, each with a single axle, two running wheels, and four guide wheels. The leading truck also carries the rollers which engage the thread bar. Each truck is centrally pivoted to the

under frame of the car body, giving the freedom of swing necessary to get round the terminal loops. The cars thus have no fixed wheel base, each wheel pair being free to take its natural radial position on curves.

The rubber tires of the running and guide wheels make the movement very quiet and smooth. It is stated that from the experience so far obtained, the tire life is likely to be at least 100,000 miles, and the tires cost but a few shillings each. Rail wear seems likely to be very light also.

The car bodies on the Southend line are of light wooden construction; each will seat eight people, and afford standing space for four more. They are octagonal in plan, the two sides parallel to the track considerably longer than the others. One of these long sides—that presented to the platform at the stations—is open, with a pillar in the centre, conveniently dividing the space into an alighting and a boarding portion—if passengers observe the order. The cars weigh about 2½ tons each, loaded, of which the greater part is in the trucks. The "dead" weight is therefore only about 300 lb. per passenger.

The driving motors are fitted with solenoid drum brakes, which can be operated from any station by press-buttons, in order to stop the whole system quickly in case of need.

The carrying capacity of the Southend line is stated to be 18,000 passengers per hour in each direction. Assuming a full load of 12 passengers per car, this works out at 1,500 cars per hour, or 25 cars per minute. The figures look rather astonishing, put in this way, but, in fact, there is a car at the platform practically all the time. The promoters claim that on the same width as that occupied by an ordinary electric train a service equal to 30,000 passengers per hour can be given.

As regards the efficiency of the screw drive, it is claimed that this is from 88 to 95 per cent.; it evidently varies with the thread angle and the coefficient of roller friction. It would be very interesting to have tests of the over-all efficiency in the form of watt-hours per ton-mile, taking in the shaft friction. Although ball bearings are well-known to have small frictional losses, a length of, say, 400 yards of screw shaft weighing some tens of tons carried in some 40 bearings suggests quite an appreciable amount of frictional loss. Perhaps the opportunity will be taken to test the Southend line for this and other particulars of interest.

The two motors driving the 600 yards of track and some 22 cars took a current equivalent to about 60 h.p., which agrees fairly well with the statement made by Capt. Sankey that the energy consumption is 40 units per hour.

The load conditions are evidently more favourable than those to which train motors are subjected, and as there are no braking losses, regeneration effected by direct mechanical coupling involving no conversion, there is a good margin out of which to cover the friction losses of the shaft, &c. But only tests can show whether there is an over-all saving, and its magnitude.

The company claims that the over-all working expenses, including capital charges, will be much lower than those of any existing transport system of equal capacity. There are some obvious savings in working expenses—for example, the absence of drivers—and, on the whole, the claim does not seem unreasonable. There is a question as regards capital charges, because the track structure, including the screw shaft and its appurtenances, is of a more expensive type than that of an ordinary electric railway, and it does not appear that the lighter rolling stock permits of any material compensation. On the other hand, there is a considerable saving in the cost of rolling stock and electrical equipment. Actual tenders for definite cases will be the only decisive basis of comparison.

It is the purpose of this article to describe a system of passenger transport which has been worked out with much ingenuity and persistence, not to criticise it in detail. There is nothing about it fundamentally impracticable or fantastic, and it will be of great interest to see it put into use for a public service. There are, it seems to the writer, certain matters which will have to be studied to meet the requirements of Government and other authorities in respect of safety and comfort. Particularly the open car does not appear to be acceptable in these respects, but it does not seem impossible to the ingenuity which is manifested in the line inspected to meet such requirements.

The company has entered for the competition instituted by the city of Paris for a system of continuous passenger transport along a defined route in that city, and is preparing the plans. It will be of great interest to everyone concerned in relieving traffic congestion in big cities if the company succeeds in obtaining the contract for this work.

The scheme certainly has promising features, and, in view of the urgency and difficulty of the problem, it will be unfortunate if it is not given a trial under really practical conditions.

LATIN-AMERICAN ELECTRICAL NOTES.

Notable Advance in Number of Brazilian Plants.

(From Our Own Correspondent.)

The directors of the La Guaira and Caracas Railway Co., which is owned by British shareholders, have had under consideration the electrification of a portion of the company's lines which have been operated by steam since 1883. Although one of the shortest in the Republic, this system ranks as the most important, connecting the capital with the principal seaport of La Guaira, and transporting nearly one-fourth of the freight carried by all the railways of the country. The gauge differs from that of the other railways centring in Caracas, being 3 ft., while that of the "German" road (Grañ Ferrocarril de Veńezuela) is 3½ ft., as is that of the Ferrocarril Central de Venezuela. The maximum grade is 3¾ per cent., and the minimum radius of curve 43 metres. Half-way up the mountain, at Zigzag, there is a switchback to reduce the grade of the way. There are 15 steel bridges, with a combined length of 281.55 metres, and tunnel with a total length of 379.5 metres. The weight of rail at present in use is 65 lb. to the yard, while the sleepers are of native hardwood throughout. The tracks of the La Guaira Harbour Corporation (also a British undertaking) are of the same gauge as those of the Caracas-La Guaira railway, and connect with them. But the rails do not go to the ships' side, goods being handled by the Harbour Corporation to the Customs' warehouses before shipment to Caracas. The present arrangement between the Corporation and the railway, however, will terminate in October next unless a fresh agreement is entered into, negotiations being in hand with that view.

The distance covered by the railway is 22 miles, or 36.65 km. The road climbs from sea-level to a pass more than 3,000 ft. high in crossing the steep coast-range between La Guaira and Caracas. It is thought

that by electrifying the line, considerable economies can be effected. A concession covering the construction of an electrical plant already exists, this having been granted to Dr. Luís Monoz Tebar, of the Escuéla de Artes y Ofícios, and covering the right to supply power for a railway between the port of La Guaira and Caracas, as well as that between Caracas and Los Teques. The only existing electric railway is the Valencia (Electrícidad de Valencia), a comparatively insignificant undertaking. Powers have also been granted for the use of the waterfall of the Manzanáres River to work the railway from Cumana to Cumanacoa.

An improved telephone system has been decided upon for the city of Tampico, State of Tamaulipas, Mexico. The city has extended enormously of late owing to the fact that it is now the centre of the Mexican oil industry; but hitherto a perfect telephone service has been lacking. The sum of $4,000,000 (Mex.) has been raised for the purpose of carrying out the installation of 3,000 telephone instruments which, it is estimated, are immediately required.

It has been decided to utilise the Toca Falls of the Santa Cruz River, in the State of Rio Grande-do-Sul (Brazil), to provide light and power for a number of municipalities in Sao Leopoldo and Taquay. A transmission line 79 km. in length will be built and will operate at 40,000 volts. The preliminary outlay upon this undertaking is estimated at 2,000,000 milreis.

The development of interest in radio has become so pronounced in Chile that in the principal cities and ports radio equipment is being freely stocked by leading importers. It is estimated that between 150 and 500 sets for broadcasting have already been installed, while a large number of other orders are in hand. Hitherto, practically all material has been imported from the United States; but the pronounced excellence of European—especially British—broadcasting and experimental sets has attracted attention, and it is thought that a considerable trade in such equipment could be successfully handled.

The Sociédad Anonyma Brasital, which obtained a concession in 1911 to cover the erection of a hydro-electric plant near the city of Sao Paulo, but which failed to carry out the enterprise, has made a renewed application for permission to build a water-power plant on the Tiete River, near the Falls of Ittu, situated a short distance west of Sao Paulo.

The city of Sao Sebastiao, in the State of Sao Paulo, is shortly to be supplied with electricity for light and power under a contract entered into with a local company. Included in the agreement is the supply of electricity to the neighbouring port of Caraguatatuba.

The municipality of the State of Rio Grande-do-Sul has called for bids for the supply of electric light and power to the capital and surrounding districts. The concession is offered for a term of 30 years, the municipality having the right to purchase the concessionaire's property at the end of 15 years. Those interested as bidders must agree to the employment of a specific amount of water power and to the provision of a service at 120 volts. It is also stipulated that power and lighting rates of a specially favourable nature must be granted to the municipality, and "moderate rates" to individuals, during the first 10 years.

A company, with a capital of 400,000 milreis, is being formed in the State of Minas Geraes (Brazil) to supply light and power to two cities.

The Servicos Reunídos de Victoria, S.A. (Brazil), a company capitalised at 1,000,000 milreis and controlled by Mr. George A. Hodge, has secured the lease of all public utilities in Victoria, on the borders of the State of Espirito Santo, and one of the termini of the British-owned Leopoldina Railway system (E.F. Sul-Espirito Santo). The lease, which runs for 40 years, with the company's option of renewal for a further 40 years, covers the operation of a hydro-electric power station, the provision of electric light and power, and the operation of tramway, telephone, water supply, and sewage systems.

Owing to a disastrous conflagration which occurred in the business centre of Rio de Janeiro recently, in which a number of large stores containing electrical goods were destroyed, the local stock of such manufactures has become almost depleted. Although a certain amount of supplies has been drawn from various stores in other places and "rush shipments" have been ordered from Europe, some time must elapse before normal conditions in the electrical goods trades can be restored.

In order to raise the sum necessary for the construction of a water system and electrical plant for the city of Comayagua, the Honduran Congress has granted permission for the imposition of additional Customs duties. That full control may be maintained over the expenditure, a Special Committee has been formed, with the Mayor of Comayagua as president, empowered to enter into all contracts for the construction work and equipment.

At the present time Mexico is offering a favourable market for electrical equipment, particularly in the district of Aguas-Calientes. During the past few years the market for electrical apparatus has been expanding, due largely to the improvement effected in the electric power facilities in the cities of Aguas-Calientes and Zacatécas. Of late months the electric lighting system has been extended to several near-by towns, and this has greatly assisted the expansion of the trade in the cheaper classes of household devices. A demand exists for electric irons, electric heating plates, toasters, and such articles, all of which are coming into more common use as electric current is developed and becomes cheaper. Mexico City importers are enjoying a brisk trade with electrical supplies ordered for the interior. Practically all electrical equipment entering Mexico is consigned to the capital, and thence distributed to the various industrial centres. Inasmuch as the Aguas-Calientes lighting enterprise is controlled by German capital and owned by German shareholders, a certain amount of German electrical manufactures is met with; but the greater part of the imports are derived from North America. Difficulty in securing consignments from Europe, except after long delays, favour American trade, which otherwise would scarcely be as brisk as it is. It is essential that prompt consignment of orders should be attended to, especially in those cases where specific items are needed in small quantities.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Crystal Detectors.

We have received from Mr. A. Hinderlich, 1, Lechmere Road, Willesden Green, London, N.W.2, a sample of a crystal pair called "Ghane" for trial; one of the elements is tellurium, the other a greenish semi-transparent substance, and the two are pressed together with a load of about 4 oz. Comparing this with a galena-gold wire detector, we found that the "Ghane" gave at least as efficient rectification, with the added advantage that it could be knocked about brutally (purposely dropped twice on a cement floor) without impairing its efficiency in the least. For circuits such as the "S.T.100," which require a stable and reliable detector, it should be especially useful.

Messrs. Mickelwright, Ltd., Alperton, Wembley, Middlesex, have sent us a simple crystal holder, the "Crystclip," made of springy wire and resembling somewhat the tube-clip of the chemical laboratory. To substitute one crystal for another is the work of a moment, and the use of set screws or Wood's metal is obviated.

A Small Coil-winding Machine.

Fig. 1 illustrates a machine made by the Plessey Co., Ltd., Vicarage Lane, Ilford, for the winding of small transformer coils, telephone coils, and small electrical coils generally.

The chief feature of this machine is the variable speed friction drive which is constructed as follows:—

A driving disk revolves in a gun-metal bearing which is pivoted, this arrangement allowing the disk vertical and horizontal movement. The disk drives a friction wheel, consisting of a leather disk which is clamped to a steel pulley mounted on the coil winding spindle.

The revolving disk (which is driven by a leather belt and

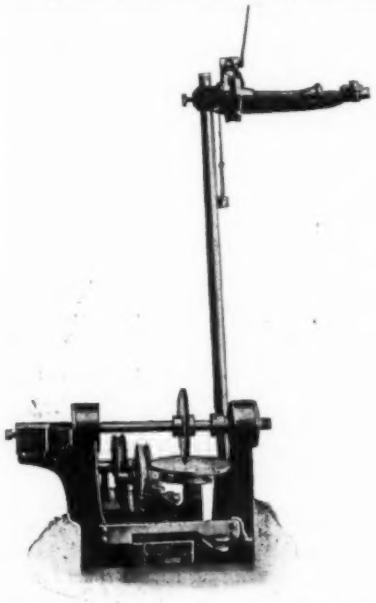


Fig. 1.—A Winding Machine for Small Coils.

pulley) is moved upwards into contact with the friction wheel. At the moment of contact, the periphery of the wheel is at the centre of the disk. The disk is then moved along horizontally by means of a handle, resulting in a smooth acceleration of the friction wheel until a maximum speed of 2,000 r.p.m. is reached at the circumference. The disk and pulley are in once piece, so that the pull of the belt serves to tighten the contact between the wheel and disk.

A "Maxlume" Home-Office Type Reflector.

Among the designs of recent date which appear in a new catalogue issued by Messrs. Veritys, Ltd., Aston, Birmingham, is a development of their "Maxlume" type of reflector, which is claimed to be the only reflector conforming to the latest requirements of the Home Office for factory and workshop lighting. The reflector is made in four patterns and four diameters. The different patterns are: For interior use, with and without lamp adjuster; and for exterior use, with and without lamp adjuster. The reflector for outside use is fitted with a ventilated cast top. The deep shape of the reflectors is claimed to give an absolute freedom from glare.

The "Norvic" Electric Fire.

Electric Fires, Ltd., King Street, Norwich, is putting a new design of electric fire (the "Norvic") upon the market.

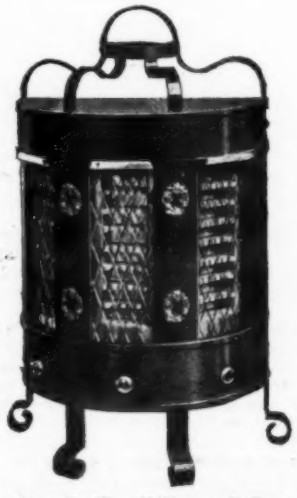


Fig. 2.—The "Norvic" Fire.

As will be seen from the accompanying illustration (fig. 2), this is arranged to project heat in three directions, giving a very wide distribution. Another practical innovation is that the reflectors, instead of being part of the fire bars, as in most "Heatrae" patterns, are carried on the hinged back of the fire, and consequently are always available for dusting and polishing. The three firebars each have a loading of 750 W, and are instantly removable without unfastening any nute, an arrangement which facilitates replacement. The fire is finished as antique brass or oxydised copper.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Power-factor Indicators.

Mr. F. E. J. Ockenden's letter of September 10th is so full of contradictions and incorrect statements that I feel I must trouble you with a further letter.

He starts off, for instance, by saying "that the similarities have nothing to do with the theory underlying his construction," but from what follows it would appear that his theory and originality measure 2¼ in. in height and weigh about 5 grammes.

Further, in trying to justify his adoption of the 120 deg. spacing of the armatures as in my three-phase instruments, he says that "this is inevitable, since the fact that three-phase systems have their phases spaced at this angle practically precludes any other arrangement."

If this argument is true in the case of three-phase working, why is it not so in the case of two-phase systems where the phase difference between the two e.m.f.'s is 90 deg.?

Mr. Ockenden is quite wrong in stating that I placed three Conrad instruments one on top of the other; on the contrary, I was the first to point out the disadvantages and limitations of that design, and succeeded in developing an entirely novel construction, working on new theoretical principles, which possesses many advantages over any other make of instruments of this kind.

Space does not permit me to repeat all the patented features of my construction, but from what I have already said in my letter of the 31st ultimo, it would appear that, so far as the moving system is concerned, Mr. Ockenden has adopted my theory and method of working in addition to the mixture of inches and grammes.

From Mr. Ockenden's reply it is fairly obvious that he does not, and cannot, deny the close resemblance and similarity between his construction and mine, but in order to camouflage his position he has now drawn up a table of only six points for which he claims originality.

My counterclaims to these six points are as follows:—

1. Throughout my patent specifications I have described certain coils as wound in pairs and arranged with narrow gaps between them, every such pair of windings energising its individual armature in correct phase sequence. This principle is applied to the pressure as well as to the current coils, and the connections of each pair of windings can naturally be either in series, or in parallel, or in opposition, *i.e.*, face to face, whichever way is best for a given case.

2. The instrument is free from temperature errors, and the frequency error is negligibly small over very wide limits.

3. The moving system is extremely light combined with an exceptionally high ratio of torque/weight.

4. Owing to the special arrangement of the field coils, the "drag torque" is practically eliminated. This is a feature of superiority in design which no other make can claim.

5. The magnetic system (as described and illustrated in figs. 5 and 6, Patent Specification No. 188,532) is influenced directly by all three phase voltages without any mutual interference, and occupies a total height of less than 2 in.

6. The essential requirement that the three current elements are working off three current transformers is fulfilled in the three-phase four-wire instrument. The moving system is either that illustrated in figs. 5 or 6 (Patent Specification No. 188,532) or that of fig. 7 (Patent Specification No. 162,471), or any other equivalent arrangement which is covered by these patents. Needless to say that the unbalanced-load power-factor meter is reading correctly on any load, balanced or unbalanced, &c.

With regard to the second part of this paragraph, Mr. Ockenden tries to make a "mountain out of a mole hill," as what he claims is of very little, if any, practical use. Indeed, no engineer with theoretical knowledge will attempt to take separate readings in the manner described by Mr. Ockenden in the case of an unbalanced three-phase circuit with unbalanced voltages, realising that only a single-phase power-factor meter, having its pressure element connected across the phase in which its current coil is inserted, can give a true indication of the power factor of each individual phase.

Moreover, the three readings taken by themselves do not provide sufficient data to arrive directly at the total power factor of the three-phase unbalanced-load circuit, as they represent vector and not scalar quantities.

I trust I have made it clear that I succeeded in obtaining all the advantages which are necessary for the user, namely, negligible temperature and frequency error, independence of current and ptessure over very wide limits, long before Mr. Ockenden started to market an instrument on the lines, I believe, that I originated.

In conclusion, I note with interest that Mr. Ockenden has tried many schemes before, but failed, where I succeeded, and I am still of the opinion that the publication of my patent specifications, &c., has been of assistance to him.

C. L. Lipman.

London, *September 18th*, 1923.

The Requirements of Foreign Markets.

It is pleasing to record that there are in the Far East one or two conspicuous exceptions to the general attitude of British manufacturers. To the observer it would seem as if the British firm is not very anxious for business as a general rule, but among the exceptions may be mentioned the English Electric Co. and the British Aluminium Co., both of which adopt aggressive business-like tactics in order to place their products—but even they have not yet ventured into the field which the American firms have come to regard as their own monopoly, namely, that of high-pressure transformers, insulators, line equipment, and structural steel. In this particular field, the foreign buyer has no recourse but to place his orders with the American producer, because he is the only one who seems to have anything to offer. This naturally gives the American a good chance to get orders for other lines where our firms can well compete, namely, generator plant, boilers, and electrical railroad material. As soon as you begin to analyse this matter you will find that the following axiom is true: The British manufacturer will produce and sell only the kind of material which is used in Great Britain. This seems to be a sweeping statement, but it meets the case.

In Australia and South Africa developments are being made particularly in the transmission of power, which are on the same scale as American practice, but are quite different from any work done in England. As an instance, the Morwell layout of the Victorian Electricity Commissioners is very similar in its engineering to the West Penn Power Co., in Pennsylvania, and this latter work was very closely studied by the Australian engineers before they began any construction. The principal electrical manufacturers in the States prepared designs for the entire work, including every detail, even such as they were not directly tendering upon. I do not know whether co-operation between British manufacturers has gone as far as this.

I have found a strong tendency on the part of the Institution of Electrical Engineers to discourage or deprecate any engineering practice which can be termed "American." The point that these gentlemen miss is simply that American practice is the only way in which we can develop the resources of Australia, India, South Africa, and the Orient, and so long as English engineers fail to study electric power engineering, save from the English standpoint, so long will they fail to get business in open competition in these countries of vast extent and resources.

Orient.

New York,
August 30th, 1923.

The Welding Current of Oil Switches.

On reading the article by Mr. Metz in your current issue, I note that he gives one watt as equal to 4.2 calories per second, whereas the correct figure is 0.24. This, however, does not involve correction of the formula he gives, although the unwary might think it does.

E. B. Wedmore,
Director and Secretary,
B.E.A.I. Research Association.

London, *September 12th*, 1923.

Mr. J. T. Barfield, in his letter of the 10th instant, draws attention to several points in my article entitled as above. I am afraid that he has not thoroughly read the text.

He refers to a number of points that really do not further come into the question at all, having already been considered. For instance, the time lag of protective gear, the point of travel at which the arcing tips part company, &c., are all irrelevant. I would remind him that it is specifically stated that the equation given is not intended for specific calculations, but rather for getting a relative comparison of a line of breakers.

G. L. E. Metz.

Manchester, *September 17th*, 1923.

What is Electricity?

Your leading article on the British Association Meeting, and the admission that we are still unable to answer the age-old question: What is electricity? prompts me to submit the following observations.

The dogmatic assurance that all matter is electricity requires to my mind some qualification.

Because matter can during dissociation produce electricity, heat and light, &c., can we say it is composed of electricity, heat and light?—Obviously not.

From appearances and certain deductions, it seems that electricity exists completely formed in matter, and the general trend of modern thought lies in this direction. I am a heretic and incline to the belief that electrons are intermediary substances between matter and the ether, and that when energy is derived from matter by certain disturbances of equilibrium of the ether following upon the partial dematerialisation of the atoms composing such matter, we then get forms of energy such as electricity, heat and light.

Matter can, I think, be attenuated into ether, and during this process electricity manifests itself.

This does not to my mind mean that matter is composed of electricity any more than coal is composed of heat.

In short, I think that matter is a storehouse of atomic energy and electricity is a product of the dematerialisation or dissociation of matter. In my address as chairman of the Leeds Section of the I.E.E. in 1908, I elaborated this theory, and suggested that the ultimate atom of matter might be a unit of electricity in its transit to the etherial state from whence it derived its energy.

I am open to enlightenment, and perhaps some of your readers will tell me where my theory breaks down.

H. E. Yerbury,
Deputy General Manager.

Electric Supply Department, Sheffield.
September 17th, 1923.

Transmission Line Problems.

I should be glad if any of your readers could furnish me with a praphical solution (and proof) of the following problem:—

The generating end voltage of a given short transmission line is known, and also the load (in kilowatts) and power factor at the receiving end. Required the receiving-end voltage.

It is comparatively easy to obtain the receiving end voltage by means of a trial and error method, using successive approximations for the regulation of the line; or the required quantity may be calculated directly by a complicated formula due to Mr. H. B. Dwight. It appears, however, that there ought to be a purely graphical method of solution applicable to the case.

H. Waddicor.

Sheffield, *September 17th*, 1923.

Ships' Life-saving Appliances.—In a paper dealing with the life-saving appliances on large passenger vessels, which was read by Mr. E. W. Blocksidge, M.I.N.A., at the Shipping Engineering and Machinery Exhibition on September 6th, and discussed by members of the Institute of Marine Engineers (Inc.), the opinion was expressed that the experience gained under the working of the present statutory regulations controlling the equipment of large passenger vessels with suitable life-saving appliances (which came into operation in 1914) makes it very doubtful whether this modern legislation has been effectual to any appreciable degree. Under the circumstances, the Merchant Shipping Advisory Committee has again given careful consideration to the subject, and has formulated recommendations for adoption by the Board of Trade, at the same time suggesting that it be afforded an opportunity to consider the revision of the existing rules.

The author of the paper thinks that in revising the present rules more attention might be given to the details of equipment carried on lifeboats, such as compasses, sea-anchor, and signalling apparatus. Complaints have often been made about the quality and effective value of such items; it would therefore be of assistance to manufacturers and surveyors if the Board of Trade requirements were given in detail in the form of a specification.

To assist the embarkation of passengers, it is considered of the greatest importance that provision should be made for the installation of a system of emergency lighting, arranged to give every facility to the boats' crews operating the launching apparatus on the boat and promenade decks and when lowering the boats down the ship's sides. Such a system of lighting would, in addition, give greater confidence to the passengers.

Amongst his conclusions the author suggests that all passenger vessels should have radio-telegraph and telephone apparatus installed; this is considered to be one of the greatest safeguards to life at sea. The value of motor boats as a part of the statutory equipment cannot be over-estimated. Recommendations are made that motor boats should be equipped with wireless telegraph apparatus and it is suggested that it would add considerably to the usefulness of the boats if they were equipped with small searchlights to assist in the safe launching of the lifeboats and the rescue of persons from the water.

THE MANUFACTURE OF STEAM.

By W. E. HIGHFIELD, M.I.E.E.

(*Abstract of Presidential address before the* National Association of Supervising Electricians.)

Efficiency is not to be obtained by decorating the boiler-room with expensive instruments. It calls for a thorough realisation of the simple fundamentals upon which good plant management is based, and in so far as these essential matters are attended to, so will economy in generation be the result. It is in the boiler-house almost entirely that good or bad station management produces the most tremendous effects.

The engine-room of a power station offers little scope for increase in efficiency due to the efforts of the operator, and if he keeps the plant in good order, gives unremitting attention to his vacuum, and never runs two units when one would safely carry the load, he can reasonably count upon satisfactory results. But the results obtained from a boiler-plant are almost entirely dependent upon the manner in which it is operated and maintained. A boiler-house is a commercial factory for making steam by the use of coal, and the aim of the manager must ever be to produce his steam with the least possible cost in fuel. In an ordinary power station it is not unusual for the cost of coal per unit of electricity generated to exceed the whole of the other costs added together, including the capital charges. The predominating part played by coal consumption in affecting costs is hardly ever realised even by those most directly concerned. Coal should be weighed coming in, as a check against the invoice weights, so that no more is paid for than is actually received. It is not sufficient to know how much coal has been burnt during a month. It is essential to know how much has been burnt on every shift, and how much water has been evaporated by its use. Only by having the figures at the end of the shift can the manager know how the plant is being operated in sufficient time to rectify any source of inefficiency the moment it occurs.

I should like to emphasise the value of the practice, adopted by many engineers, of letting the boiler-house staff know exactly the results they are obtaining, shift by shift. The effect of doing this is to make the men keenly interested in their work, and to cause them to feel that they are doing something essential to the well-being of the undertaking. By posting up in the boiler-house, day by day, the evaporation results obtained by each shift, preferably in the form to which I shall refer later on, the natural sporting spirit of the men is aroused and the healthy desire to continually improve on their previous records generates a spirit of efficiency which has a most happy effect on the relationships between the management and the operating staff. No man, or set of men, can be expected to obtain the best results if they never know what kind of results they are getting, and nothing but good comes from keeping the operating staff fully informed as to the progress of the plant in efficiency and output.

To obtain the figures to which I have referred it is necessary to have some means of weighing the coal and metering the water or steam on every shift, and it is preferable that measurements should be made in respect of every separate boiler. It is as absurd to try to operate a station properly without measuring apparatus in the boiler-room as it would be to try to do without meters on the switchboard. The apparatus need not be of laboratory accuracy. No boiler-house can be properly run without these measurements. The question is not whether the cost of the necessary measuring apparatus can be afforded; the point is rather that no station can afford to be without the apparatus.

The small station can be as relatively efficient as the large station, and an all-round improvement in the small stations would make a great difference to the all-round efficiency of the stations considered as a whole. The average annual fuel consumption per unit generated in small stations varies from 3.38 to 20.9 lb. These figures show the importance of the coal and water measuring instruments. It is quite possible to put in so many instruments, both direct reading and recording, that it is impossible for the staff to properly analyse the results obtained. This is quite a serious matter, because it has a moral influence on the staff and the value of the measurements is apt to fall into contempt. I put forward a strong plea for simplicity and for concentration on essentials.

Presuming then that the boiler-house is equipped with apparatus for ascertaining the pounds of coal burnt and the pounds of water evaporated during every shift, the obvious thing to be done is to calculate the evaporation obtained per lb. of coal. When the results are examined a considerable variation will be noticed. Every station engineer knows that the greater the output the greater in general will be the evaporation figure, and it soon becomes evident that the effect of the variation of the output may be quite sufficient to mask important variations in operating efficiency. A direct comparison between the evaporation figures would, therefore, be misleading unless this fact was taken into account.

In order that the operating efficiency of any shift may be determined, regardless of the output, so that the performance on any shift can be usefully compared with that on any other, a very simple method of dealing with the results was devised some years ago by Mr. R. H. Parsons, who was at the time the engineer and manager of a large station abroad.* On a piece of squared paper a scale of ordinates is marked off in pounds of coal burnt per shift, the base being similarly marked off in lb. of water evaporated per shift. The performance during any shift can be represented by a dot on the chart at a distance above the base line equal to the number of lb. of coal burnt, and at a distance to the right of the origin equal to the weight of water evaporated. By recording the performances of a number of shifts in this way a series of dots are obtained, which lie in a slanting direction across the chart. The line which lies most evenly among the dots is drawn in, and this line becomes the criterion of performance of the station. If, at the end of any shift, the dot corresponding to the performance lies above the line, then more coal was burnt during that shift than should have been consumed to evaporate the particular quantity of water used.

A similar line may be obtained connecting the quantity of coal burnt with the electrical output. The Parsons lines make it possible to see at the end of every shift exactly how the performances of the boiler-room and engine-room have compared with the standard performance, and they give this information definitely and in time for immediate steps to be taken to remedy any lapse of efficiency which may be disclosed. The method is applicable to power stations of every size and type, and has been adopted by some of the most important ones in the country. I commend it to your notice as being the most practical means I know of deriving immediate benefit from the coal and water records of the station.

CO_2 meters, temperature indicators, flow meters, &c., all are important, but it is often sufficient to arrange these instruments so that they are not necessarily in service continuously, but only used when the coal and water measurements show that one particular boiler is not being used efficiently. Particularly is this the case with a small station where the cost of such instruments on every boiler is prohibitive. While it is very important to maintain the CO_2 percentage as high as possible, so long as CO is not present, and for this purpose a CO_2 indicator or recorder is indispensable, I wish to utter a warning against the idea that all must be well in the boiler-room if the CO_2 figures are satisfactory. The engineer does not want CO_2 but steam, and the CO_2 record by itself conveys no information as to whether this steam is being raised with the minimum amount of coal. A high CO_2 figure, combined with a low stack temperature, is certainly significant of efficiency of operation, but the real test is the amount of steam made in comparison with the quantity of coal burnt. The CO_2 recorder, like the flue-gas pyrometer, is a purely secondary and subsidiary instrument, whose main function is to assist in locating the cause of inefficiency.

The general tendency towards an increase in pressure is very marked at present. One of the reasons is to reduce the size of pipes necessary for carrying the enormous amount of steam which has to be transmitted in modern large power stations. There are, for example, turbo-generators running which consume as much as 150 tons of steam per hour, and the conveyance of such large quantities is no small matter.

On the other hand, as showing what can be done with comparatively low-pressure steam, I may mention the results obtained at the Radcliffe station of the Lancashire Electric Power Co. There, in spite of the fact that the working pressure is only 160 lb. per square inch, the station results for six months gave a coal consumption of only 1.866 lb. per kilowatt-hour delivered to the feeders. This example is sufficient to show what results careful management of the boiler-house will give.

Before deciding on an increase in pressure the increased capital cost must be weighed against the probable saving. Naturally high-pressure plant costs more than low-pressure plant. Not only do the boilers cost more but the auxilliaries, the pipework, and other items increase in a regular proportion.

Without going into details the general tendency appears to be for very large stations to be laid down for pressures between 350 and 500 lb. For medium-size stations there appears no reason for going beyond 350 lb. The cost of plant for 350 lb. is very little different from that of plant for 250 lb., whereas beyond 350 lb. the cost increases considerably.

*See Electrical Review, February 21st, 1919, p. 200; and "The Coal Consumption of Power Plants," by R. H. Parsons (Electrical Review, Ltd.).—Eds.

BUSINESS NOTES.

Bankruptcy Proceedings.—Cyril Walter Stocken and Conway Fink, trading as the Wyndham Radio Supplies, 80, Redcliffe Street, Bristol.—The first meeting of creditors was held on September 12th at the Official Receiver's offices, 26, Baldwin Street, Bristol. The statement of affairs showed liabilities expected to rank at £754, due to unsecured creditors, and the assets were estimated to produce £347, leaving a deficiency of £407. Debtor attributed his failure to insufficient turnover since the commencement of the business, slackness of trade during the summer months, want of capital, and pressure by creditors. It appeared that debtors commenced business in partnership at Narrow Wine Street, as wireless engineers, in March, 1922, subsequently removing to their present address. Their capital amounted to £162, borrowed from Mrs. Stocken, to provide stock, and £114 of this amount was still owing to her. The debtors stated that they were unable to develop their business owing to the delay of establishing British broadcasting. An adjournment of the meeting was asked for, as it was understood that friends of the debtors would come forward and offer a composition of 10s. in the £ cash. After some discussion the meeting was adjourned.

The following are creditors:—

	£		£
Abrahams, J.	35	Morris & Griffiths, Ltd.	15
Burroughs, C. W.	25	Mountstevens, F. H., Advertising	25
Clerke, H., & Co. (Manchester), Ltd.	15	Rose Bros. Electrical Co., Ltd.	50
Colchester Electrical Co.	30	Shenton & Co., Ltd.	12
Coxon, W. K.	14	Siemens Bros. & Co., Ltd. ...	16
Edison Swan Electric Co., Ltd.	15	Simpson, Baker & Co.	70
General Electric Co., Ltd. ...	40	Stocken, Mrs. B. J. L.	116
		Welch & Co., Ltd.	150

Arthur Curtiss Stuart and Cyril Perrier, trading as The Stuart Wireless Telephone Co., 109, Kingsway, London.—In this case, particulars of which recently appeared in these columns, the following are the principal creditors:—

	£		£
Adams, G.	74	Oxenpost, Dudley	19
Ashdown, H. E., Ltd.	63	Preen & Co., Ltd.	50
British Radio Wireless Mfg. Co., Ltd.	35	Slee, J.	25
Brandy, H.	16	Service, R. (St. Clement's Press)	137
Chloride Electrical Storage Co., Ltd.	11	Smith, W. S.	121
Czalis, J. P.	74	Semaphore, Ltd.	23
Copeland, P. E.	41	Taylor, H. B.	17
Carrington & Newberry, Ltd. ...	18	Walton, H	12
Doulton & Co., Ltd.	14	West, T. F.	12
Davies, J.	30	Watkins, A. E.	24
Dennison, Oats	13	Weyers Bros.	18
Fleming, Birkby & Goodall, Ltd.	13	American Hard Rubber Co. ...	24
Fellows Magnetos, Ltd.	100	Boots, Ltd.	81
Goswell Engineering Co.	17	Brown, G., Ltd.	92
Gent & Co.	101	Day, Bertram	100
Grimshaw, Baxter & J. J. Elliott, Ltd.	26	Couldrey, A., & Co.	35
Gamble Bros., Ltd.	15	Churchill, C., & Co.	83
Herd Bros., Gerner, Ltd.	20	Crystal Mfg. Co.	14
Harvey, G. A., & Co., Ltd. ...	12	Hervé, L., Ltd.	50
Hereport, C. W.	34	Keliher, —	15
London Electric Wire Co. and Smiths, Ltd.	33	Mundav & Son, Ltd.	16
Merton & Sons (London), Ltd. ...	12	Mullard Radio Valve Co. ...	30
Melhuish, —	31	Saxton, Chatterton & Co. ...	35
Mayell, W. A. S. C., & Co. ...	33	Sterling Telephone and Electric Co., Ltd.	50
		Telegraph Condenser Co. ...	53
		London Telephone Service ...	34

Charles Frederick Mason Metcalf, trading as C. F. Metcalf, 8, Cow Green, Halifax, electrical engineer.—The first meeting of the creditors of the above was held recently at the County Court House, Prescott Street, Halifax. The statement of affairs showed gross liabilities of £2,994, of which £2,778 was expected to rank for dividend, against assets of £2,248, or a deficiency of £530. Debtor attributed his position to the failure of a limited liability company to pay money due to him. The creditors decided to appoint Mr. C. H. Baker, of 1, Albion Street, Leeds, as trustee, while a committee of inspection was also nominated.

Horace John Albert Maullin, 206, Lozells Road, Hockley, Birmingham, house painter, and trading as The Wilton Engineering Co., 124, Devonshire Street, Birmingham, electrical engineer.—The application for discharge of this debtor was heard on September 13th at the Court House, Corporation Street, Birmingham. It was stated that the receiving order was made on September 8th, 1922, and the ranking liabilities were estimated at £254. The proofs actually submitted and claims not yet lodged amounted to £243, while the assets, which were estimated to realise £133, have produced £132. The balance available for costs and distribution among the creditors was £81, and a first and final dividend of 4s. 4d. in the £ was paid on proofs for £217. It appeared that debtor commenced business in 1890 at 3, George Street as a house painter and decorator with £900 received under the will of his mother. In February, 1921, he also commenced business as an electrical engineer at 124, Devonshire Street, when he had £400 capital, the balance remaining of the £900 with which he originally started. The latter business was not successful, and he attributed his failure to bad trade. The discharge was granted subject to a suspension of two years.

A. Vivian, electrical engineer, 180, Gray's Inn Road, W.C.—Last day for proofs for dividend, October 4th. Trustee, Mr. D. Williams, Official Receiver, Carey Street, W.C.

W. E. Weeks, wholesale electrical dealer, 59, Victoria Street, and 12, Filton Avenue, Horfield, Bristol.—Last day for proofs for dividend, October 2nd. Trustee, Mr. J. P. Emett, 18, Nicholas Street, Bristol.

Company Liquidations.—A. C. Cutting & Welding Co., electric welders, 25, Theobalds Road, London, W.C.1.—In pursuance of the provisions of the Companies (Consolidation) Act, a meeting of the creditors of the above was held on September 11th, at the offices of the liquidator, Mr. W. H. King, C.A., 13/14, Basinghall Street, E.C. A statement of affairs was submitted which showed liabilities of £3,000, of which £2,857 was due to unsecured creditors, and the balance was in respect of a claim by partly secured creditors for £200, who held securities valued at £57, leaving £253 to rank as unsecured. There was also a fully secured creditor for £4 12s. 6d., holding securities valued at £20, leaving a surplus of £15 7s. 6d. The assets totalled £1,117, from which had to be deducted £41 for preferential claims, leaving net assets of £1,135, subject to the costs of liquidation. The statement, therefore, showed a deficiency of £1,955 as regarded the creditors. The assets consisted of: Cash, £2 8s. 4d.; debenture received from a debtor, £9; good book-debts, £410; stock, machinery and fittings, £2,600, estimated to produce £500; surplus from fully secured creditors, £15; and licence, cost £2,631, valued at £200. The company was registered in May, 1919, with a nominal capital of £20,000, of which £5,300 was subscribed by the vendors in April, 1919, and in November they subscribed a further £2,900, of which £2,300 was paid up in cash and £600 in machines, so that the total subscribed capital was £8,321. A trading account prepared showed that to April, 1920, the sales were £8,000, with a net loss of £2,900. For the 12 months to April, 1921, the sales amounted to £12,000, with a net loss of £1,100. To April, 1922, the sales were £9,300, with a net loss of £932, but this loss was later turned into a profit. For the year to April, 1923, the sales were £5,700, and there was a further loss of £1,100. Asked as to the failure of the company, Mr. King stated that there was never sufficient money to pay the overhead expenses. In reply to Mr. W. Baker, it was stated that salaries and wages had been about £2,500 a year. No resolutions were passed, and the voluntary liquidation of the company will, therefore, be continued, with Mr. King as liquidator.

Premier Electrical Supplies, Ltd., 3, New Oxford Street, London, W.C.—Pursuant to Section 188 of the Companies (Consolidation) Act, 1908, a meeting of the creditors of the above was held on September 12th, at Pagani's Restaurant, 42, Great Portland Street, W., when the liquidator in the voluntary liquidation of the company, Mr. T. Payne, 80, Lancaster Road, West Norwood, presided. A statement of affairs presented showed liabilities £174, all due to unsecured creditors. The net assets were £32, or a deficiency of £142. In reply to Mr. Judd, of Messrs. Corfields Traders Association, 181, Queen Victoria Street, E.C., the liquidator stated that the company was incorporated in February, 1923, with a nominal capital of £1,000, to acquire an existing business previously carried on by Messrs. A. H. Tappy and R. B. Hill, under the style of Premier Electrical Supplies, the consideration for the goodwill, &c., being £450, satisfied by the allotment of fully-paid shares. In addition, 550 shares were subscribed for in cash. It would appear that the turnover was £328, on which a gross profit was made of £49, and the expenses had been £450. The directors drew £5 a week each. Asked by Mr. Judd whether any deficiency account was prepared, Mr. Payne replied that he had not prepared one. After discussion the meeting broke up without any resolutions being passed; the liquidation, therefore, remains in the hands of Mr. Payne. The following are creditors:—

	£		£
A.C. Trading Co.	10	Metallite Co., Ltd.	15
Ever Ready Co. (Great Britain), Ltd.	10	A. & A. Electrical Co., Ltd. ...	10
Faultless & Co.	10	Benham, Barrett, Synott & Wade	22
General Electric Co., Ltd. ...	18	Robert Richards	15

Vulcan Arc Welding & Transport Co., Ltd.—Winding up voluntarily. Liquidator, Mr. W. M. Paul, 49, Whitechapel, Liverpool. Meeting of creditors, September 20th. Particulars of claims to the liquidator by October 6th.

James Brown Lamp Manufacturing Association, Ltd.—A meeting of members is called for October 20th at the Post Office House, Infirmary Street, Leeds, to hear an account of the winding-up from the liquidator, Mr. A. Dobson.

Direct United States Cable Co., Ltd.—A meeting of members is called for October 19th at 238, Winchester House, Old Broad Street, E.C., to hear an account of the winding-up from the liquidator, Mr. W. Miles.

Dissolutions of Partnership.—W. Arnott (Firm), consulting electrical engineers, 163, Hope Street, Glasgow.—Mr. W. Arnott and Mr. W. L. Arnott have dissolved partnership. Mr. W. Arnott will attend to debts and continue the business.

Easby & Davies, electrical, mechanical, and motor engineers, Little Thomas Lane, Redcliffe Street, Bristol.—Mr. F. V. Easby and Mr. G. B. Davies have dissolved partnership.

Private Arrangements.—The Central Supplies Co., Ltd., electrical and wireless factors, 4, Cross Street, Finsbury Pavement, E.C.—A meeting of the creditors in this matter was held on September 17th at the offices of Messrs. Trayton P. Child & Son, C.A., 36/37, Queen Street, E.C., when Mr. Child presided. A statement of affairs presented showed liabilities £797, all due to unsecured creditors. The assets consisted of office furniture and fittings £20, estimated to produce £10; stock in trade £318, estimated at £250; book debts £118, valued at £100; and cash in hand £1 12s. 4d.; making total assets £362, from which had to be deducted £81 for preferential claims, leaving net assets £280, or a deficiency of £517. It would appear that the company was formed in February, 1917, with a nominal capital of £2,000. The subscribed capital amounted to £692. Mr. Child stated that he had an offer to make of 5s. in the £, payable on or before October 1st, 1923, and after discussion the creditors decided to accept the offer. The following are creditors :—

	£		£
Anglo-Continental Trade and Commerce, Ltd.	25	Daimon	66
Benenson & Co., Ltd.	11	Israel & Oppenheimer	14
Byworth, C. W.	50	Lyons, J. H.	15
Cohn, E. A.	142	Rose Bros.	60
Cohn, H. E.	40	Samter, G. A.	227
Cox's Shipping Agency	23	Trevor, I.	30

Palmer, Riley & Co., Ltd., electrical factors, 90, Abbey Street, Accrington.—A meeting of the creditors in this matter was held in Manchester recently, when a statement of affairs presented disclosed liabilities £6,733, all due to unsecured creditors. There was also a fully secured creditor for £1,200, who held security valued at £1,500. The assets consisted of office furniture, £25; motors, £80; stock estimated to produce £2,000; book debts valued at £2,500; and a surplus from security in their hands of fully secured creditors, £300; making total assets £4,905; from which had to be deducted £69 for preferential claims, leaving net assets £4,836, or a deficiency of £1,896. It was stated that Messrs. Palmer & Riley started the business in March, 1920. They retired from the business at the end of 1920, when a Mr. Hoyle was introduced. Trading figures showed that for the year to March 31st, 1921, the turnover was £3,641, on which a net profit of £311 was made for the nine months to December, 1921, the turnover was £19,381, but there was a loss of £1,772; for the year to December, 1922, the turnover was £25,000, and there was a loss of £455; while for the half year to June 30th, 1923, the turnover was £8,083, and there was a further loss of £2,385. The present position was attributed to bad management by the early directors, over-buying of stock, and trade depression. An offer was made of 10s. in the £ in settlement of debts as at July 31st last, payable in four equal instalments over six months, and all indebtedness incurred since July 31st to be paid in full. The creditors decided to appoint a committee of inspection, consisting of the British Thomson-Houston Co., Ltd., Edison Swan Electric Co., General Electric Co., Ltd., Western Electric Co., Ltd., and W. T. Henley's Telegraph Works, Ltd., to investigate the company's affairs and report to an adjourned meeting.

Trade Announcements.—Messrs. C. A. Vandervell & Co., Ltd., have removed their registered office from Pinners Hall, Austin Friars, E.C.3, to Warple Way, Acton, W.3.

City Stockrooms, Ltd., of 5, Bond Street, Bradford, has opened fifteen well-equipped stockrooms at St. George's Hall, Bradford, for the use of travellers in all lines of goods, including electrical and similar fittings and appliances. The rooms are within easy access of both the chief railway stations of Bradford and of the city's principal hotels. Bradford has long been handicapped—and particularly so since the demolition of a famous old hotel in the centre of the city—by shortage of trade stockrooms, and many travellers have had to show their goods at Leeds, involving serious inconvenience both to themselves and to Bradford and district retailers.

Messrs. Hook & Willis, Ltd., of 74, Goding Street, Vauxhall, London, S.E.1, have been appointed sole British agents for Messrs. Kaupy & Schonmann, of Vienna, manufacturers of "Durabit" insulating tape.

Mr. H. M. Todd has removed to more central premises at 124, Govan Road, Mavisbank, Glasgow.

Mr. B. Quarmby, who is relinquishing his connection with the Metropolitan-Vickers Electrical Co., Ltd., and is commencing business in Huddersfield as an electrical factor, wishes to receive manufacturers' catalogues and lists at 1061, Fern Lea, Linthwaite, Huddersfield.

Catalogues and Lists.—Messrs. Mavor & Coulson, Ltd., 47, Broad Street, Mile End, Glasgow.—Tenth edition of catalogue containing full descriptive and illustrated matter relating to the "M. & C." bar, chain, and disk coal-cutters; also reprints on the care and working of these machines.

A.C.E.C., 56, Victoria Street, London, S.W.1.—Quarterly Bulletin No. 99, containing technical articles on series three-phase motors, electrical pumping at Antwerp dry docks, steel works, electric cranes, and other subjects.

The Telegraph Condenser Co., Ltd., Norwich House, Southampton Street, High Holborn, W.C.1.—Brochure No. 31, describing static condensers for the improvement of power factor. Fully illustrated.

"M. K." Electric, Ltd., Park Road, Edmonton, N.18.—An illustrated price list of "Multy-Kontact" switches, connectors, switch-plugs, &c.

Mr. O. N. Beck, 11, Queen Victoria Street, E.C.4.—An illustrated pamphlet dealing with the "Record" tube expander.

Messrs. James Gordon & Co., Ltd., Windsor House, Kingsway, London, W.C.2.—Pamphlet describing the "Duplex Mono" gas analysing apparatus, which records combustible gases as well as CO_2.

The City Electrical Co., Ltd., London.—Leaflet giving a list of users of their motors.

Messrs. Belling & Co., Montague Road, Upper Edmonton, London, N.18.—Catalogue of electric fires for the 1923/24 season. Some useful notes on electric heating, its cost, &c., are followed by a series of pictures appealing to the housewife and illustrated details of many designs of "Belling" fires, including the "Reflector Coal," the "Corinthian," the "Imitation Coal," and other new fires. Large stocks are held.

Credenda Conduits Co., Ltd., Whitehouse Street, Aston, Birmingham.—September price list of "Credenda" wires, cables, and flexibles.

Industrial Management.—A series of lectures is to be given under the auspices of the Industrial League and Council, in co-operation with the Regent Street Polytechnic. The lectures commence on October 12th with inspirational addresses to the students by the Rt. Hon. G. N. Barnes and Mr. W. L. Hichens. After that, the subjects will be confined to expert lecturers, who include Mr. A. W. Kimberley, on "The Financial Organisation of Industry"; Mr. A. P. M. Fleming, M.Sc., on "Industrial Research"; Mr. A. R. Stelling, Dipl. Ing., on "Factory Management"; Mr. H. Atkinson, on "The Relative Rewards of Capital, Management, and Labour"; Mr. James F. Butterworth, on "Motion and Fatigue Study"; Dr. Edgar L. Collis, on "The Safeguarding of Health in Industry"; Mr. H. W. Allingham, on "The Economic Aspect of Cost Accountancy"; and Mr. F. S. Button, J.P., on "The Attitude of Labour to Problems of Industrial Organisation." The fee for the whole course is 5s.; single lectures 1s. Tickets can be obtained from the general secretary, Industrial League and Council, 82, Victoria Street, S.W.1.

Australian Foreign Trade.—His Majesty's Senior Trade Commissioner in Australia (Mr. S. W. B. McGregor) informs the Department of Overseas Trade that the statistics of Australian trade for the year ended June 30th, 1923, show that the imports were £131,808,673, as compared with £103,066,436 for the previous year, an increase of £28,742,237. Exports amounted to £117,913,083, as compared with £127,846,535 for the previous year, a decrease of £9,923,452. The imports included the following :—

	1921-22. £	1922-23. £
Electric cable and wire, covered ...	888,184	1,205,706
Electrical machinery and appliances	3,098,925	3,380,424
Other machines and machinery ...	5,632,713	5,883,879
Steel rails, fishplates, &c.	87,474	453,696
Wire—iron and steel	297,865	824,134
Rubber manufactures	984,404	1,841,792
Glass and glassware	765,271	1,065,131

Applications for British Trade Marks.—The following are among the recent applications for British trade marks. Objections may be entered against any of the proposed marks within one month from the dates mentioned. In the case of foreign applications the names and addresses of the British representatives are also given :—

Radiofone, Best British Built (lettering and design). No. 428,099. Class 8. Wireless receiving sets of British manufacture. Edith M. Russell, trading as the Lincoln Trust Co., 62, Oxford Street, London, W. September 12th, 1923.

British Best Built, Best by Test, London. No. 428,100. Class 8. Wireless telephony receivers and receiving sets, all of British manufacture. Edith M. Russell, trading as the Lincoln Trust Co., 62, Oxford Street, London, W. September 12th, 1923.

Inducta. No. 434,909. Class 8. Electric accumulators and batteries. Schweizerische Magneta Gesellschaft, 1, Hofstrasse, Zug, Canton of Zug, Switzerland (Harold J. C. Forrester, Jessel Chambers, Chancery Lane, London, W.C.). September 12th, 1923.

Atalite. No. 439,366. Class 8. Crystal detectors for use in wireless telegraphy and telephony. Dixon & Co., 36, Duke Street, Bevis Marks, London, E.C. September 12th, 1923.

Vanicon. No. 439,435. All goods in Class 8. The Dubilier Condenser Co. (1921), Ltd., Ducon Works, Goldhawk Road, Shepherd's Bush, London, W. September 12th, 1923.

Adlyte (lettering and design). No. 428,611. Class 13. Electric incandescent lamps (ordinary). Ludwik Rozen, trading as L. Rozen & Co., 36-37, Mincing Lane, London, E.C. September 12th, 1923.

Minicop. No. 438,822. Class 13. Electric switches of ordinary metal. The Dubilier Condenser Co. (1921), Ltd., Ducon Works, Goldhawk Road, Shepherd's Bush, London, W. September 12th, 1923.

Fish Spine (lettering and design). No. 439,129. Class 10. Electric insulators made of porcelain or earthenware. Taylor, Tunnicliffe & Co., Ltd., Eastwood Works, West Terrace, Hanley. September 12th, 1923.

Ladder Improvement.—We understand that Mr. Heathman, of Parson's Green, London, has just effected a further improvement in his automatic ladder lock.

The Swiss A.E.G.—The Swiss branch of the Berlin A.E.G. has been transferred from Basle to Zurich, and has been given the title of the A.E.G. Electricity Co.

Book Notices.—*Manual of Electrical Undertakings and Directory of Officials*, 1922-23. By E. Garcke. 26th annual edition. London: Electrical Press, Ltd. 30s. net.—The new edition of this valuable *Manual* has come to hand. It now occupies a thoroughly-established position amongst the essential works of reference relating to electrical companies and the greater part of the industry. The progress of the past year is recorded in tabulated statistical form, new and proposed legislation, the decisions of the Electricity Commissioners respecting joint electricity authorities, and many other matters being covered. In a number of separate sections, as usual, there are given particulars of electricity supply and traction undertakings in the United Kingdom, and those in the British Dominions and possessions, also telegraph and telephone undertakings of the Empire, British electrical manufacturing and miscellaneous companies, &c. There are directories of officials, electrical contractors, &c., and the supplements include 35 maps of railway and tramway routes, electricity supply areas, and so forth. The information relating to the thousands of undertakings which are particularised, is personal, financial, parliamentary, and technical.

"Engineering Directory," No. 70, September, 1923. London: *Engineering*, Ltd.

"Matriculation Magnetism and Electricity," by R. H. Jude and J. Satterley. Pp. vii+415; illustrated. London: Universal Tutorial Press, Ltd. Price 6s. 6d.

"Small Electric Motors," by E. T. Painton. Pp. xi+120; figs. 55. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

Annual Sports.—The annual sports meeting and garden fête of the Elliott Social Association, in connection with Messrs. Elliott Bros. (London), Ltd., of Lewisham, was held on Saturday, September 1st, at Colfe's Grammar School ground at Eltham Green, about 600 members and friends being present. The representatives of the company included Mr. W. O. Smith (president, E.S.A.), Sir Keith Elphinstone, K.B.E., and Mr. L. W. Smith, with their wives and friends, Mrs. W. O. Smith declaring the fête open. The sports programme included running and walking races, inter-departmental tug-o'-war (ladies and gents.), obstacle race, pillow fight, three-legged race, flower-pot race, skipping race, inter-departmental and visitors' relay race, high jump, ladies' races, &c. Competition in the inter-departmental tug-o'-war (men) this year was very keen, owing to the fact that Mr. W. O. Smith presented a silver challenge cup in connection with this event. The winners were the tool-room team—runners-up the indicator shop,—after an exciting struggle. A silver challenge cup was also given by Sir Keith Elphinstone for the inter-departmental relay race, which was finally won by the staff team. The invitation relay race of one mile was won by the team from Messrs. Siemens Bros., Ltd., of Woolwich. A special programme was arranged for the children, under the supervision of Mr. and Mrs. L. W. Smith, and these events were very popular. There were many side-shows and competitions, and teas and refreshments were provided. The music was provided by the band of the 91st Brigade R.A.F., T.F. The prizes were, with a few exceptions, given by the directors of Messrs. Elliott Bros., and presented to the various winners by Lady Elphinstone.

Payment by Results.—The members of the Amalgamated Engineering Union are balloting the Royal Dockyards on the suggestion of the Admiralty that the principle of payment by results, now operating in the constructive department, should be extended to the engineering trades. The ballots were to have been completed in time for the meeting of the Shipbuilding Trades Joint Council on Wednesday last.—*The Times*.

Australian Union Urges Higher Duties to Protect Engineering Production.—The attention of the Customs authorities was recently directed to complaints of insufficient tariff protection made by the Castlemaine branch of the Amalgamated Engineering Union. It was asserted that overseas firms had been able to quote 20 to 50 per cent. less than Australian tenderers, and in consequence manufacturers outside the country had secured more than 40 per cent. of the total engineering contracts in the Commonwealth. It was explained that the policy of the Tariff Board was in all cases to do its utmost, within the Act and the tariff, to encourage the Australian engineering industry. The test of whether an industry was entitled to special consideration was whether it was being subjected to unfair outside competition. The Deputy-Controller-General of Customs and acting chairman of the Tariff Board stated that in no instance within his knowledge had the difference in cost between the Australian and overseas manufacturer extended to 50 per cent. of the value of the machinery. The action of the Customs department hinged upon whether the machinery could be manufactured in Australia. If it could be commercially manufactured there no consideration was given to any application for free admission. In cases where the machinery was absolutely necessary for the foundation of a new industry, however, or for the expansion of an existing industry, the department gave favourable consideration to applications for remission, always bearing in mind the capacity of the local engineering interests to meet the demand.—*Reuter's Trade Service* (Melbourne).

For Sale.—Rotherham Corporation Electricity Department has for disposal two 1,000-kW turbo-alternators, complete with condensers, a.c. and d.c. panels, feed pumps, six water-tube boilers, and two Lancashire boilers. By direction of the George Cohen and Armstrong Disposal Corporation, Messrs. Allsop & Co. will sell by auction at the R.A.F. Depôt, West Drayton, on October 9th and following days, insulated and other cables, electric lamps, insulators, fittings, &c. (See our advertisement columns to-day.)

Russia and Teheran Exhibition.—Russia is taking a deep interest in the Teheran Exhibition, and is sending from Petrograd, for show in the Russian Section, a series of light motors, electric lamps, &c.

The British Empire Exhibition.—Electrical Installations, Ltd., has been appointed electrical contractor of the Industrial and Machinery Halls at the Exhibition. It is at present engaged in carrying out the electric lighting installation of these two halls and for other exhibition buildings, and has just finished the complete electrical installation of the Stadium.

The Swansea Corporation has decided to contribute £150 towards the cost of the co-operative electrical display at Wembley next year, and Sunderland has als odecided to give financial aid to the scheme.

South American Trade.—The London and River Plate Bank, Ltd., 7, Princes Street, London, E.C.2, has issued its monthly review (September) of business and trade conditions in South America.

German Journal in Difficulties.—In consequence of the financial stress in Germany, an appeal has been issued by the *Technische Zeitschriftenschau*, the organ of the Verein deutscher Ingenieure, for a public subscription to help to continue the publication of that journal.

New Italian Companies.—There has been formed at Rome the Società Centrale per Distribuzioni Elettriche, with a capital of 1,050,000 lire, for the generation and supply of electric current. The Società Impresa Elettrica Fiumicino (Isola Sucra) has also been formed at Rome, with a capital of 100,000 lire; its intended field of operations is apparently at Fiume and neighbourhood.

At Milan has been embodied the Fabbriche Elettrotecniche Riunite, with a capital of 50,000 lire, for the manufacture, sale, and representation of electrical apparatus and material.

Electric Light Increases the Letting Value of House Property.—Among the points raised at Edinburgh Valuation Appeal Court was one as to whether the installation of electric lighting increased the valuation of a house. The appeal was put forward by a resident, who claimed that owing to leakages in gas pipes he had been compelled, for health reasons, to install electric light, and that his rental had been increased solely because of that. The Assessor submitted that electric light increased the letting value of a house. The rent fixed by the Assessor was £42, but the Court reduced this to £41.

Canadian Imports of Electrical Apparatus.—Electrical apparatus to the value of $1,212,115 was imported into Canada during the month of July, $92,423 coming from the United Kingdom and $1,079,886 from the United States. The principal items of imports under this heading were:—Storage batteries to the value of $53,302, dynamos and generators $106,010, insulators $72,463, motors $146,584, controllers $64,609, switches and switchboards $79,283, and telephone instruments $57,288. Imports from the United Kingdom included storage batteries to the value of $16,028, dynamos and generators $18,900, electric motors $14,304, telephone instruments $8,654. —*Reuter's Trade Service*.

The Best is Cheapest.—A Fleetwood electrical engineer (Mr. G. H. Yeo) has a sign bearing the following inscription in his shop window:—

We don't do cheap work,
We do good work cheap.

Gasfilled Lamps in Russia.—Success having attended the production of gasfilled lamps in the Svyetlana factory, the Electromachine Construction Trust has decided to cease the purchase of such lamps abroad.

Local Exhibitions.—Rawtenstall.—On September 15th, an eight days' electrical exhibition was opened by the Mayor (Councillor Barritt) in connection with the Electricity Department. About a dozen firms exhibited electrical appliances, illustrating a wide variety of applications.

South Shields.—An exhibition, arranged by the municipal electricity department and the General Electric Co., Ltd., is being held in the Y.M.C.A., South Shields. The display comprises domestic electrical appliances of all descriptions. The Mayor (Alderman E. Smith), in opening the exhibition, said that they were offering some inducement in the shape of lower rates to consumers. The Electricity Committee had also under consideration a scheme for hiring out cooking apparatus at reasonable rentals, and the Council, he thought, would adopt it in the near future.

New Russian Company.—A new company has been formed at Ekaterinburg for the construction and exploitation of a power station at the peat marshes near the town. The capital is 2,000,000 gold roubles.

Three-electrode Variable Condensers.—Messrs. Autogross, Ltd., 84, Victoria Street, Westminster, whose W.V.C. catalogue was recently noticed in these columns, inform us that they received such a rush of inquiries and orders that they were unable for a time to cope with the demand; but are now in a position to supply by return.

Patent Revoked.—An order has been made revoking Patent No. 29,631, of 1910, granted to Vernon Hope, for "Improvements in Fuse Boxes for Controlling Electric Circuits."

Russian Chemical Works Electrified.—The central power station for the Bondyuzh chemical factory was recently started. The construction was begun in 1917, but for various reasons its completion was delayed. It is a 750-kW station, and it is intended to add a 500-kW turbo-generator for reserve. It will be fuelled exclusively on peat from its own factory.

Unemployment.—The number of persons on September 10th recorded on the live registers of the Employment Exchanges in Great Britain as wholly unemployed was 1,221,700. This was 11,600 less than in the preceding week, and 264,178 less than the figure recorded on January 1st, 1923. The number working short-time and drawing benefit for intervals of unemployment was 75,400 on September 10th, as compared with 72,839 on September 3rd, and 56,261 on January 1st, 1923.—*The Times.*

LIGHTING AND POWER NOTES.

Aylesbury.—Electricity Charges.—The Ministry of Transport has issued an Order fixing the maximum charge for electricity at 9d. per kWh, with minimum payments of 11s. 3d. for the winter quarters, and 7s. 6d. for the summer quarters.

Extensions.—On Tuesday last week the 1,500-kW B.T.H. turbo-alternator which has recently been installed was formally inaugurated, the three-year old grandson of the Deputy-Mayor, Ald. J. Robinson (chairman of the Electricity Committee), being privileged to start it. Afterwards the electrical engineer, Mr. W. A. Turnbull, conducted the large party of spectators through the works, and refreshments were served. The undertaking, which had 175 consumers in 1916, now has nearly 1,000, and is rapidly developing. The generating plant, which was recently tested by Mr. W. M. Selvey, presents features of exceptional interest, which will be described in a later issue.

Barnoldswick (Yorks.).—Electricity Scheme.—The Urban District Council is to take a referendum of the ratepayers with view to ascertaining whether they are in favour of an electricity supply and has instructed its consulting engineer to prepare and submit a scheme for consideration.

Burton-on-Trent.—Extension of Supply.—The Electricity Committee has agreed to extend the mains to Winshill, Stapenhill, Horninglow, and Horninglow Cross.

Barnsley.—New Plant.—The Corporation is installing new plant at the electricity works at a cost of £37,000.

Eaglesham.—Proposed Electricity Supply.—At a recent public meeting the question of obtaining an electricity supply was considered and it was decided to obtain the advice of a consulting engineer.

Hove and Aldrington.—Year's Working.—The report of the engineer and manager (Mr. C. B. Smith) on the working of the Hove electricity undertaking for the year ended March last shows a total revenue of £49,616 as compared with £45,007 in the previous year. Working expenses amounted to £35,220 (£26,107), leaving a gross profit of £24,396 (£18,900). After payment of capital charges there was a net profit of £6,549. In the previous year there was a surplus of £6,049. The number of kWh sold increased from 1,456,861 to 1,864,723, and the average price per kWh obtained was 5.90d.

The working of the Aldrington electricity undertaking for the past year shows a total income of £4,595 (£4,171). Working expenses absorbed £3,077 (£3,111) leaving a gross profit of £1,518 (£1,060). After meeting capital charges, &c., there was a net profit of £529, as compared with £339 in the previous year. The number of kWh sold rose from 129,913 to 156,376.

Irish Free State.—Ballybay (Co. Monaghan).—The Castleblayney Rural District Council is applying to the Ministry of Industry and Commerce for sanction to erect a power station for the supply of electricity to Ballybay.

Navan.—The Urban District Council has arranged to take over the plant of Messrs. Spicer, and a supply of electricity for public use will be available from October 1st.

Guiseley and Yeadon.—Special Order.—The Electricity Commissioners have made a Special Order, granting power to the Electrical Distribution of Yorkshire, Ltd., to supply energy for public and private use in the district.

Knaresborough.—Electricity Supply.—The Urban District Council has entered into an agreement with Harrogate Corporation for a supply of electricity.

Paisley.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £7,000 for electricity purposes.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

Fareham.—Lighting: 8d. per kWh.

Fulham.—Private lighting: From 5½d. per kWh to 5d.; slot meters, from 6d. to 5½d. per kWh. Power and heating: From 1½d. per kWh to 1⅛d. per kWh. Public lighting: From 1⅛d. to 1.65d. per kWh.

St. Pancras.—Ordinary lighting: From 5d. to 4½d. per kWh. Factory lighting and kinema supplies: From 5d. to 3d. per kWh. Power: The kilowatt demand system of charge at £1,440 per annum, plus 1d. per kWh, to be reduced to £720 per annum, plus 1d. per kWh.

Hackney.—Lighting: Alternative No. 1: £3 per quarter, plus 1d. per kWh. Alternative No. 2: 5½d. per kWh. Alternative No. 3: Prepayment meters, 8d. per kWh. Heating and cooking: 1d. per kWh. Power: Alternative No. 1: £1 10s. per kW per quarter, plus ¾d. per kWh. Alternative No. 2: 2d. per kWh.

Weymouth.—Lighting: From 8d. to 7d. per kWh. Power and heating: From 2½d. to 2d. per kWh. Public lighting: From 4d. to 3½d. per kWh.

Milnrow.—Extension of Supply.—With a view to affording a supply of electricity to Newhey the work of laying cables, &c., is to be commenced forthwith.

Newport (I. of W.).—Electricity Charges.—As the result of an inquiry held last February into the application of the Isle of Wight Electric Light & Power Co., Ltd., for an Order to increase the maximum prices for electricity, the Ministry of Transport has issued an Order to the effect that the current prices are to continue in force.

Normanton (Yorks.).—Electricity Scheme.—In connection with the proposal to obtain an electricity supply from the Yorkshire Electric Power Co., a revised report has been submitted to the Urban District Council, which shows the cost of a sub-station, transformers and mains to be £5,557. The application for sanction to a loan to carry out the work has been amended accordingly.

Queensbury.—Electricity Supply.—The District Council has received a communication from the Electrical Distribution of Yorkshire, Ltd., stating that the Electricity Commissioners have refused to grant a Special Order authorising the company to give an electricity supply to the district. The Council is therefore applying to Halifax and Bradford Corporations for terms upon which they would be willing to give an electricity supply.

Rugeley.—Opposition to Scheme.—The Urban Council has informed the Electricity Commissioners that it is opposed to the inclusion of the Urban District in the Cannock Electricity Extension Order, on the grounds that the distribution of electricity should be in its own hands, and that in view of the probability of a power station being erected in or near Rugeley it would be in a position to distribute electricity at a cheaper rate, or failing that, a bulk supply could be obtained from the Cannock Urban Council.

Skipton.—Inauguration of Supply.—The bulk electricity supply obtained from Keighley was formally switched on by the chairman of the Electricity Committee on September 12th.

Slaithwaite.—Transfer of Electricity Order.—The Urban District Council proposes to transfer its Electricity Order to the Electrical Distribution of Yorkshire, Ltd., and has appointed a sub-committee to meet the Yorkshire Electric Power Co., Ltd., with a view to arranging terms for the transfer of the Order.

South Africa.—Beaufort West (Cape Province).—The Municipality proposes to erect a power station, with a view to generating its own electricity. A supply for public lighting is at present obtained from the railway power station.

Tring.—Electricity Supply.—The Urban District Council has under consideration a proposal to obtain an electricity supply from Aylesbury Town Council.

United States.—Hydro-Electric Development.—According to the *Journal of Electricity*, the new Laguna Bell sub-station of the Southern California Edison Co. was brought into operation on August 2nd. The 220,000-V transmission lines from Big Creek power station have been extended from Eagle Rock sub-station to Laguna Bell, a distance of 30 miles. Transformers of 220,000/60,000 V have been installed. It is claimed that this is the first sub-station designed for 220,000-V operation to be placed in service at that voltage. The cost of erecting the station was $1,000,000, and electricity will be distributed for industrial purposes in the Los Angeles district.

Weymouth.—Loans Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to the borrowing of £8,992 for a 350-kW gas-engine set, and £2,000 for services.

Whitstable.—Electricity Charges.—The Ministry of Transport has granted an Order enabling the Whitstable Electric Co., Ltd., to charge 9d. per kWh for lighting, and 4½d. per kWh for power, the Urban Council to apply for a revision after three years.

Whitworth (Lancs.).—Electricity Supply.—The Urban District Council has received a communication from the Electricity Commissioners for further particulars of estimated income and expenditure in connection with the electricity scheme. The electrical engineer of Rochdale Corporation has submitted amended details showing a reduction in capital outlay from £15,966 to £11,354.

Wormit.—Electricity Supply.—Following on the decision of a meeting of ratepayers in Wormit to promote a company for the supply of electricity, a circular has been issued, stating that steps will be taken to form a company as soon as the capital has been assured.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—New Route.—The Tramways Committee has recommended that the tramways be extended from the Rubislaw terminus along Skeine Road to the Council's estate at Hazlehead, at an estimated cost of £47,000.

Australia.—Melbourne.—Two tramcars collided on September 15th, 30 persons receiving injuries. Another accident occurred on September 16th. Eighty people were injured.

Belgian Congo.—Railway Electrification.—The Belgian Government's scheme for the electrification of the eastern part of the colony was recently the subject of a Ministerial statement. It is considered that 100,800 h.p. could be obtained by harnessing falls on the Congo, while 30,000 h.p. is needed to electrify the Matadi-Leopold line. The cost of the work is estimated at 50,000,000 fr., and it will take from four to five years to carry out the scheme.

Bradford.—Loan Sanctioned.—The Corporation has received the sanction of the Ministry of Transport to the borrowing of £8,239 for the reconstruction of the Duckworth Lane tram route from Toller Lane to Little Lane and improvements at the siding at Duckworth Lane depôt.

Clitheroe.—Proposed Light Railway.—At a recent meeting of the District Council a letter was read from the promoters of the Longridge to Hellifield Light Railway, requesting the Council to support the project. The Council has agreed to receive a deputation on the subject.

Continental.—Austria.—The formal opening of the first section of the electrified Arlberg railway from Innsbruck to Telfs took place on July 22nd. Other sections are expected to be completed before the end of the year.

The administration of the municipal tramways in Vienna has requested large electrical firms to take up the question of the proposed conversion of the Vienna city railway to electric traction. Contracts will be placed as soon as the Vienna municipality has received the sanction of the Federal Administration to take over the railway, for which 50 motor-cars and 120 trailers are to be built, together with car sheds and track and overhead conductor work.

Sweden.—It is reported from Geneva that the total expenditure incurred on the electrification of the Federal railways between 1907 and 1922 amounted to 220,179,000 fr. This sum includes the outlay on the acquisition of waterfalls, erection of works, construction of locomotives, &c.

Italy.—Although the Société Turinaise de Tramways has recently disposed of its tramway system in Milan to the municipal authorities of that city, it is still working the provincial system. At present the lines are operated by steam, but in conjunction with the local authorities of the districts served, a scheme of reorganisation, including the electrification of the lines, is being prepared.

United States.—New Electric Railway.—Financial interests in Greenville, Tenn., have applied for permission to construct a railway between Knoxville and Bristol, Tenn., which will be electrically operated, at a cost of $5,000,000.—*Reuter's Trade Service* (New York).

York.—Proposed Tramways Extension.—The City Council has under consideration a request from the ratepayers for the extensions of the tramways to the Poppleton road district.

TELEGRAPH & TELEPHONE NOTES.

Australia.—Wireless Telegraphy.—The amount paid by the Commonwealth for the purchase of shares in the Amalgamated Wireless Co. was £50,000 5s., being 2s. per share on 500,001 shares. The amount paid by the company was £21,811 14s., being 2s. per share on 304,117 new shares, and £1 fully paid on 181,400 shares of the old company.—*Age* (Melbourne).

Finland.—Telephone Service.—A report has been presented to the Government of Finland by the committee appointed in 1919 to consider the question of bringing the country's telephone system into a satisfactory condition, and to make technical proposals for the installation of lines and exchanges. Besides making recommendations in these directions the committee, which had to obtain all the material for its work from abroad, submits a draft scheme for those who may seek to get concessions for the establishment of networks.

New Cable.—Cable Ship Mishap.—The cable ship *Faraday* arrived at Halifax on September 13th, and reported that she lost the end of the Commercial Cable Co.'s new cable which she was laying between America and Europe, when 900 miles out. After having searched for two days and failed to locate the cable, the *Faraday* returned to Canso, Novia Scotia, and laid the shore end. She is proceeding to New York, whence she will trail a cable to the broken end.

Another cable ship, the *Colonia*, has laid 2,000 miles of the Canso-Azores stretch of the cable.—*Reuter.*

This cable, which is being laid for the Commercial Cable Co., will join London and New York, *via* Weston-super-Mare, Waterville, and the Azores. One steamer left Rockaway, Long Island, on the 1st inst. for the Azores, paying out cable. Another vessel, the *John W. Mackay*, under the command of Capt. Larnder, O.B.E., left Weston-super-Mare on Wednesday last week for Waterville, where she put in two days later and landed the cable, which was tested and found in good order. This section is to be linked up with another to the Azores, and the cable will then be complete across the Atlantic. It is expected that the new service will be working within a week. It will have a capacity for transmitting 60 letters per minute each way. The Waterville cable station is still one of the most important in the world. There are about ten separate cable systems joined to the station, which is thus directly connected with many of the busiest and most important centres of the world. The present staff at Waterville numbers 130 highly skilled operators, under the supervision of Mr. D. H. Walsh.

RADIO NOTES.

Broadcasting over Wires.—During the last eighteen months the North American Co., through its subsidiary, Wired Radio, Inc., has been experimenting with a system of wired-radio "broadcasting" over electric lighting and power lines, under the basic patents of Major-Gen. G. O. Squier. General Squier has granted an exclusive licence to Wired Radio, Inc., for this purpose, and the system is being developed in co-operation with a number of large lighting and power companies. No transmitting or receiving aerials are used; instead, the sending apparatus is connected to one phase of the three-phase buses at the power house, and the radio waves follow along the wires to the receiver, which is plugged into any electric lamp socket or convenient outlet in the home, just as an electric fan, iron, or toaster is connected.

New types of simplified transmitting and receiving apparatus have been developed. One of the receivers is a combined tuner, amplifier and "loud speaker" in a small cabinet. Current for lighting the filaments is supplied from the 110-volt lighting mains through an ordinary lamp-cord connection, which also carries the radio waves into the receiver, where they are amplified and converted into voice and music. No antenna, ground connection, storage battery, or special wiring is required, and any number of receivers may be operated simultaneously in a home or apartment house without interference. An adjustment permits reception of the ordinary space-radio programmes. A wired-radio programme of a comprehensive kind is to be furnished which will be continuous from early morning until late at night. Later on, the company expects to offer more than one programme on various wave-lengths, and tuning dials are provided on the receiving sets for this purpose.—*Electrical World.*

New Three-Electrode Valve.—The "Wecovalve."—The Western Electric Co., Ltd., and other makers of thermionic valves announce that on October 1st a new valve known as the "Wecovalve (pea-nut type)" will be placed on the market. This valve consumes only 0.25 A at 0.8 to 1.1 V, so that it can be fed with a single dry cell; it is stated that the valve is equally efficient as a detector, high-frequency or low-frequency amplifier, and that it has more than twice the life of any other type of valve.

Radio-Telegraphy in South America.—Our special correspondent writes as follows:—Radio-telegraphy continues to make rapid strides in Argentina. Governmental support is being given in all directions, the latest arrangement including the equipment of the Chamber of Deputies at Buenos Aires with telephone communication to the radio station at Palermo. This installation will have a range of 2,000 km., and it will be possible to broadcast the debates to all listeners-in. Moreover, it is intended to equip motor trucks with receiving apparatus, so that the public in the capital and other cities of Argentina may hear what goes on in the Assembly.

The improvements effected at the radio station of the Cuban Telephone Co. of Habana allow of an effective radius

approximately 3,000 miles on a wave-length of 400 metres. Messages sent from Habaña to Prince Albert (Saskatchewan, Canada) have been heard with startling clearness, while other stations at long distances which have reported are Catalina Island, Visalia (California), and Porto Rico.

A new wireless station has recently been erected at Trinidad, in the Province of Santa Clara, Cuba. Located near the port of Casilda, the station has towers built upon the same plan as those on the Atlantic coast of the United States. The modern 2-kW high-frequency transmitter can change instantaneously from 300 to 1,400 metres wave-length, and, under normal conditions, has an approximate range of 700 nautical miles by day and 1,200 by night. Wireless stations now provide the southern coast of Cuba, which is considered one of the most dangerous for the coasting trade, with almost complete protection.

Wireless Exhibition and Convention. — Arrangements have been made to hold an All-British Wireless Exhibition and Convention at the White City, Shepherd's Bush, W.12, from November 8th to 21st. The exhibition is being organised in conjunction with the National Association of Radio Manufacturers, and wireless interests in the country will be fully represented. It had previously been decided to hold a wireless exhibition at the Horticultural Hall, Westminster, at the end of the present month, but, having regard to the more comprehensive arrangements necessitated in connection with the National Association of Radio Manufacturers, it was felt that the White City would furnish more fitting accommodation. Consequently the arrangements for the earlier exhibition were postponed and revised so as to amalgamate with this larger exhibition in November. The organisers are Messrs. Bertram Day & Co., Ltd., 9 and 10, Charing Cross, S.W.1. The wireless broadcasting demonstrations will be in the hands of the British Broadcasting Co., Ltd.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Australia.—Melbourne (Victoria).—October 6th. Electricity Commissioners. 22,000-V insulators.*

October 24th. Victorian Government Railways. Electric mists.*

Adelaide (South Australia).—October 30th. S.A. Harbours Board. Four 7-ton electric travelling coal-unloading cranes. Specifications from the offices of the Board, Victoria Square, Adelaide.

Sydney.—December 3rd. City Council. H.p. feeder and pilot cables.*

Barking.—October 9th. Electricity and Tramways Committee. Reconstruction of the Barking and Becton Light Railways. Rails, fish plates and bolts, permanent way construction. (See this issue.)

Belgium.—September 26th. Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. 300 tons of bronze wire in five lots. Particulars (2 fr. 30 c.), Cahier des Charges, No. 740.

Municipal authorities of Juprelle, Paifve, and Wihogne, all in the Province of Liége. Concessions for the electric lighting of the respective towns.

Blackburn.—October 3rd. Board of Guardians. Supply of a Hobart electric mixing machine. Particulars from Mr. C. E. Bygrave, Clerk to Board of Guardians, Union Offices, Cardwell Place, Blackburn.

Cheadle and Gatley. — October 8th. Urban District Council. Sub-station switchgear. (See this issue.)

Chile.—The Chilean State Railways are calling for bids for the installation of signals to be used on the Santiago-Valparaiso electric line, and for telephones for the southern system of railways.

Croydon.—September 27th. Board of Guardians. Six months' supplies of electrical appliances. Mr. N. P. Walker, Clerk to the Guardians, Mayday Road, Thornton Heath.

Denmark.—Copenhagen.—October 11th. Municipal Council. One electric crane for unloading coal.*

Dublin.—September 24th. City Electricity and Public Lighting Committee. Coal meters for use in connection with mechanical stokers, Pigeon House electricity works. Particulars and specification from city electrical engineer, Fleet Street, Dublin.

Edinburgh.—October 1st. Corporation. Electrical installation in connection with two blocks of houses. Mr. J. D. Gibson, surveyor, 60, Frederick Street.

Egypt.—Cairo.—October 27th. Education Department. One generator, two electric motors (12 h.p.), two ditto (6 h.p.), with switchboards, &c., required for Cairo model workshops. Specification can be obtained from the Stores Department of the Ministry of Education.—*Reuter's Trade Service* (Cairo).

Falmouth.—October 15th. Board of Guardians. Installation of electric lighting at the Poor Law Institution. (See this issue.)

Formby.—October 1st. Urban District Council. H.p. feeder cable, l.p. service cables, feeders and tee boxes, lamp standards, sub-station equipment, h.p. and l.p. switchgear. (September 14th.)

Haddington.—Co-operative Society. Work (including electric lighting and power) in connection with the alterations at Market Place, North Berwick. Mr. Thos. Deans, general manager, Lodge Street, Haddington.

India.—September 25th. Great India Peninsula Railway. Steel rails and fishplates, cast-iron chairs, points and crossings, steel fish bolts and chair bolts, &c., required in connection with the electrification of the Bombay suburban lines. Forms from the company's offices, 48, Copthall Avenue, E.C.2.

Irish Free State.—Dublin.—September 28th. Commissioners of Public Works. Electrical supplies for 12 months. Mr. J. J. Healy, Secretary, Office of Public Works, Dublin.

September 29th. Electricity Lighting Department. One 38-h.p., 3-phase motor for Pigeon House Works. Mr. J. J. Murphy, town clerk.

Howth, Co. Dublin.—September 26th. Urban Council. Provision of street electric lighting installation. Mr. J. Moore, town clerk.

Drumcondra, Dublin.—September 22nd. Wiring of St. Columba's Catholic Church. Messrs. J. P. Tierney & Co., consulting engineers, 44, Kildare Street, Dublin.

Leicester.—Electricity Department. Four water-tube boiler equipments, complete with superheaters, economisers, pipework, &c. (September 7th.)

London.—H.M. Office of Works.—October 3rd. Electric wiring in steel conduits at the New Science Museum, South Kensington, S.W. (September 14th.)

London County Council.—October 15th. One 15,000-kW steam turbo-alternator and condensing plant for the Tramways Department. (September 14th.)

October 15th. Single and double pole track and test panels. (See this issue.)

October 2nd. Removal of steel- and brick-lined chimney stack at the L.U.E.T. power station, 74, High Road, Chiswick. Particulars from the general manager, L.C.C. Tramways, Victoria Embankment, W.C.

October 8th. Withdrawing, repairing, relaying, and jointing existing l.p. cables. (See this issue.)

Metropolitan Asylums Board.—October 10th. Electric lighting installation in the old East Cliff House at Princess Mary's Hospital, Margate. (September 7th.)

Islington.—October 8th. Cleansing Department. Two new lead batteries for 3½-ton Orwell & Edison dust-collecting vehicles. (See this issue.)

Hanwell, W.7.—October 5th. Managers of the Central London School District. Extension of the electric lighting installation at Greenford Avenue School. (See this issue.)

Manchester.—September 29th. Waterworks Committee. Electric motors, with speed-reduction gear, transformer and converting plant, cables, wiring &c., in connection with the driving of two sets of reciprocating hydraulic pumps. (September 7th.)

Motherwell and Wishaw.—Burgh Council. Electric lighting installation (50 houses). Schedules from Town Clerk, Motherwell.

Newcastle-on-Tyne.—Remodelling of heating and lighting installation at the City Hospital, Walker. Mr. Ernest Hatton, engineer and general manager, Transport and Electricity Undertaking, Manors, Newcastle-on-Tyne.

Newcastle-under-Lyme.—October 3rd. Electricity Department. Two e.h.p. truck type feeder panels for the electricity station, and one do. for the Knutton sub-station. (See this issue.)

New Zealand.—Wellington.—October 31st. Post and Telegraph Department. 30,000 dry cells for telephones.*

Public Works Department. November 27th. Two recording instrument panels.*

Leven.—October 3rd. Horowhenua Electric Power Board. Lightning arresters, switches, &c.*

November 20th. Portable testing instruments.*

Rochdale.—Electrical fittings for Rochdale Workmen's Club, Brickcroft Street. Particulars from the secretary.

Salford.—September 24th. Electricity Department. Cooling towers, pumping plant, and pipework at Agecroft power station. (September 7th.)

South Africa.—Johannesburg.—November 1st. Municipal Council. Joint box compound, cut-outs, and insulating tape.*

Sunderland.—October 15th. Board of Guardians. Static transformer, main switchboard and distribution mains, well motor drive, wiring central area, certain specified blocks and East Block, motors, &c. (See this issue.)

Swinton and Pendlebury.—September 29th. Electricity Department. 300-kW rotary converter, with switchgear. (See this issue.)

Uruguay.—MONTEVIDEO.—October 25th. State Electricity Works. 130,000 metres of electrolytic-tinned copper wire.*
November 1st. 35,500 metal-filament electric lamps.*
24,750 fuse fittings, including 3,000 distributing fuses with bipolar or tripolar fuses, for Edison screw plugs.*

Walsall.—October 10th. Electricity Supply Committee. Two boiler units complete with superheaters, economisers, steel chimneys, feed pump, pipe work and auxiliaries. (September 14th.)

Warrington. — October 1st. Electricity Department. Motor-driven air compressor. (September 7th.)

Windsor. — September 24th. Board of Guardians. Electric lighting installation at the Windsor Poor Law Institution. Mr. W. W. Nobbs, 50, Fairhead Gardens, London, N.W.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Seven concerns recently submitted tenders to the municipal authorities of Hecht for the establishment of a l.p. electricity distribution system in the town, the best offer being that of the Société de l'Energie et Lumière Electrique, of Liége.

Six concerns—four Belgian and one each Swiss and German—competed for the recent order of the municipal authorities of Schaerbeek, Brussels, for the supply of 200 electricity meters, the lowest tender being that of the Société Belge pour la Fabrication des Compteurs, of Brussels.

Brierfield.—District Council. Accepted:—
Installation of electric lighting on the market ground.—Mr. H. Ashworth.

Dundee.—Free Library Committee. Accepted:—
Installation of fire alarms in Albert Institute at an initial cost of £600, with an annual charge of £11.—Mr. J. Malloch.

Falkirk.—The Electricity Commissioners having sanctioned the following extensions at the electricity works:—3,000-kW turbo-alternator, 25,000 lb. per hour boiler with economisers and chimney, and a cooling tower 200,000 gallons per hour capacity, the Electricity Committee has placed the contracts for the turbo-alternator with the Brush Electrical Engineering Co., Ltd.; the boiler, economiser, and chimney with John Thompson's Water Tube Boilers, Ltd.; and the cooling tower with the Premier Cooler & Engineering Co.

Grays.—Urban District Council. Accepted:—
Converter machinery (£4,922).—Metropolitan-Vickers Electrical Co., Ltd.

London.—ST. PANCRAS.—Electricity and Public Lighting Committee.

Additional storage battery at the King's Road power station.
864 amp.-hour capacity at 10-hour rate, lead-lined boxes (£602).—Chloride Accumulator Co., Ltd. (Recommended.)
Main exhaust pipe at the King's Road power station (£138).—G. N. Tanner. (Recommended.)
Additional cubicle to e.h.p. switchgear, Grafton Road sub-station (£385).—British Thomson-Houston Co., Ltd. (Recommended.)

Coal for the Electricity Department.

Bentinck nutty slack, 125 tons per week (24s. 11d. per ton); Hall's Cadley nutty slack, 150 tons per week (21s. 11d. per ton); Barber, Walker Selston, nutty slack, 150 tons per week (21s. 2d. per ton); Coppice, 1¼-in. nutty slack, 100 tons per week (22s. 11d. per ton); 600 tons Ramcroft large hards (34s. 11d. per ton).—J. H. Beattie and Co., Ltd.
Stockingford 1¼-in. slack, 100 tons per week for 3 months (19s. 3d. per ton, plus 2s. 9d. per ton cartage).—T. S. & C. Parry.

Pittington.—Parochial Council. Accepted:—
Installing electric light in Hallgarth Church.—Devereaux & Moodie.

Stafford.—Electricity Committee. Accepted:—
Two sets of switchgear for sub-stations at the Lammascotes and Messrs. Bagnall's works, at £397 per set, exclusive of transformers and l.p. panels.—Ferguson, Pailin, Ltd.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

REQUESTS for information must be accompanied by a stamped addressed envelope.

We should be glad if any reader could advise us of the name and address of the makers of:—

ABCAR vacuum cleaners.

NOTES.

Electrically-driven Ice-making Plant.—In connection with the description of the Poynernook ice-making plant of the Aberdeen Steam Trawling and Fishing Co., which appeared in our issue of September 7th, we understand that the ice crushers on this installation are driven by "Emcol" totally enclosed motors, specially supplied for this purpose by Messrs. Walter McGee & Son, Ltd., of Paisley; these motors have to work under unusually damp conditions, but have given no trouble since their installation. The plant of the Bon-Accord Ice Co., of Aberdeen, is also completed equipped with "Emcol" motors, which, we are informed, have given excellent results.

The United States and the World Power Conference.—More than twenty American engineering, technical, and industrial associations have appointed representatives to a national committee which will make plans for United States participation in the World Power Conference to be held in London in connection with the British Empire Exhibition in July next.—*Reuter's Trade Service* (New York).

Michael Faraday.—To-morrow—September 22nd—is the anniversary of the birth of Michael Faraday, the father of electrical engineering, whose memory should be venerated by every member of that great industry. We are pleased to note that the *Yorkshire Evening News* is to publish to-morrow the following special message from Lord Haldane:—

LEST WE FORGET.

Michael Faraday was one of the world's greatest geniuses. Although not properly a mathematician, he divined what have been developed into tremendous mathematical conceptions. The work he began in this domain and applied especially in connection with electromagnetic phenomena, was carried on after his death by a disciple worthy of him, Clerk Maxwell. The doctrine of the "field" was their work, and Einstein and Planck and others have cast yet further light on the region Faraday discovered.

As an experimental physicist, Faraday brought to bear scientific imagination, giving rise to verified insight of the highest order. The exact observer and the poet are not so far removed from each other as people are apt to think. Goethe told this to the world long ago. Faraday would have been a man after Goethe's own heart had the latter lived long enough to study his work.

Safety in Mines.—The first report of the Safety in Mines Research Board was recently issued (H.M. Stationery Office, price 9d. net). Its contents deal mainly with questions relating to the use of explosives, falls of roof, coal-dust and firedamp explosions, diseases, &c., and with the measures that have been taken to conduct researches into these matters. It is stated that an investigation into the capacity of vented flanges to prevent the passage of flame from the casings of mining electrical gear has been completed, and a report is in preparation. Other electrical researches are in progress regarding signalling systems, telephone systems (with special reference to magnetos that will be efficient and yet incapable of igniting explosive gases), and shot-firing apparatus (which also are liable to ignite firedamp). Apart from the actual apparatus, the Board is concerned with the phenomena resulting from the use of electricity, as regards their effects on the ignition of firedamp and coal dust. Accompanying the striking of an arc or the passage of a spark, there is a mechanical effect which causes a wave or pulse in the surrounding medium. The character of this pulse varies with the character of the electric spark (whether capacity or inductance), as does the energy concentration in the spark. The study of the influence that these variations have on the ignitibility of explosive mixtures should throw much light on the reasons for their ignitibility. These researches deal with the limiting sparks that are capable of causing ignition.

When heavy currents are broken, or blow fuses, mechanical pressure-effects are produced by the arcs; these effects being superimposed on the chemical effects of combustion of explosive mixtures, intensify their action. For example, flame-proof enclosures that may resist the passage of flame of an explosive mixture that has been ignited by comparatively mild means, may be quite inadequate when the mechanical effect of an arc also comes into play.

During the period covered by the report work has been carried on by experiments with flame-proof switchgear, and by determination of the pressure effects caused by the striking of momentary arcs in closed vessels.

With regard to miners' nystagmus, the Miners' Nystagmus Committee has reported that the essential cause is deficient illumination, due partly to the low illuminating power of the safety lamps used by coal miners, partly to the distance at which these lamps have to be placed from the objects which a miner has to look at, and partly to the great absorption of light by coal. There seems to be no doubt that miners' nystagmus would be almost completely prevented if an illumination equal to that given by naked lights could be produced by means of safety lamps.

Appointments Vacant.—Chief electrical engineer, for the Skipton Urban District Council; instructor in electric wiring and installation work, for the Borough Polytechnic Institute. (See our advertisement pages to-day.)

Inquest.—On September 12th, the inquiry into the death of Richard Chester Pearson (39), of Horwich, a moulder employed at the Hindsford Foundry, who was killed while casting a mould, was re-opened. At the previous hearing workmen had complained of electric shock whilst working about the works, and it was stated that in 1919 a moulder named Patterson was killed under similar conditions. Pearson was casting a mould when the ladle apparently became alive with electricity from a supporting frame, and he collapsed. Mr. W. Brown, Inspector of Factories, said that the earthing wires were totally inefficient. The jury held that no criminal negligence could be attached to the present management, and a verdict that death was due to paralysis of the heart caused by electric shock from a defective frame was returned.

Educational.—Battersea Polytechnic.—Electrical Engineering Department, session 1923-24. Day and evening courses commence on September 24th. Calendar of Technical College for Day Students, 4d., post free. Calendar of Evening Classes gratis on application to the Principal, Mr. R. H. Rickard, F.R.S. (See our advertisement pages to-day.)

Power Circuits and the Post Office Regulations.—In the *Journal* of the Tramways and Light Railways Association for September a letter from the Electricity Commissioners to the Incorporated Association of Electric Power Companies is reproduced. The letter, which is dated August 23rd, 1923, refers to a conference held on August 24th, 1922, at which were present representatives of the Post Office, the I.M.E.A., the Incorporated Association, the Provincial Electric Supply Committee, and the Electricity Commissioners. At this conference the matters discussed included the laying of P.O. lines in proximity to power lines, the allocation of the cost of the necessary protection of the P.O. lines when the Post Office was the second comer, the Commissioners' overhead line regulations, and the P.O. overhead line regulations, copies of the last-named (Circular E 17) being distributed for consideration by the other parties. Correspondence ensued, of which a summary is given. The Commissioners propose to call a further conference to discuss these matters.

Fire.—A serious fire recently completely destroyed Messrs. Robins's electrical and wireless works at Cathays, Cardiff. The fire appears to have originated in adjoining premises, and other premises were involved. The total damage is estimated at between £2,000 and £3,000.

Production Cost at Connors Creek, U.S.A.—The operating costs of the Connors Creek station, of the Detroit Edison Co., for the year ended June 30th, 1923, show the best thermal efficiency yet reported by the plant, the improvement being due to closer attention to details and more uniform quality of fuel, and not to any basic change. The station is still without economisers. The output figure given below is net metered output to the transmission system, all station and yard uses of energy having been deducted. The output is measured at the transmission voltage of approximately 24,000.

The plant economy, 19,600 B.th.u. per kilowatt-hour, is better than 1922, when the figure was 19,660. The maximum demand has increased almost 10 per cent., to 158,500 kW, while the total output has increased 10.3 per cent., to 676,907,100 kWh. The average load throughout the year was 77,300 kW, an increase of 10.4 per cent. The load factor is practically the same as in the previous year, being 48.8 per cent. The coal consumption was 1.58 lb. per kWh. The Connors Creek plant is not a base-load plant and takes its share of the fluctuations in load drawn by the entire system.—*Electrical World.*

Production Expenses per Kilowatt-Hour for 1922-23.

	Cents.
Operation:	
Superintendence	0.011
Wages	0.055
Fuel	0.461
Lubricants	0.001
Station supplies and expense	0.007
Total	0.535
Maintenance:	
Station buildings	0.010
Steam equipment	0.035
Electrical equipment	0.003
Total	0.048
Total production expense	0.583

Annual Festival of the E.T.B.I.—The Annual Festival of the Electrical Trades Benevolent Institution will be held at the Trocadero Restaurant on Wednesday, November 14th. Sir Philip Nash has kindly agreed to be president of this Festival, and it is hoped that members of the electrical industry will give him their strong support both by contributions to the funds and by their presence at the dinner.

Fatality.—One of the victims of the boating accident at Loch Insch, Badenoch, on Thursday last week, was a young engineer, Mr. Keith Stuart Mackenzie, B.Sc. After a period of service with the Brunton Wire Mills (electrical department), Musselburgh, he received an appointment in the Edinburgh Corporation Electrical Department. He was a keen sportsman, and was on the loch with a companion, who was also drowned.

The Effect of Oxygen on Copper.—A paper on "Investigation of the Effects of Impurities on Copper. Part I: The Effect of Oxygen on Copper" was presented by Mr. D. Hanson, D.Sc., Mr. C. B. Marryat, B.Sc., and Miss Grace W. Ford, B.Sc., at the autumn meeting of the Institute of Metals, in Manchester, on September 12th. The paper described the effect of oxygen, up to a concentration of 0.36 per cent., on the properties of pure copper. The investigation dealt with the casting of the metal, cold rolling, hot rolling, density of chill-castings and rolled bars, tensile tests at ordinary and at elevated temperatures, hardness tests, fatigue tests, notched-bar impact tests, electrical conductivity, microstructure of castings, microstructures of the alloys in various conditions, and determination of the solubility of oxygen in solid copper.

The results indicate that oxygen has a relatively small effect on the properties of copper, and is neither seriously deleterious nor remarkably beneficial. The mechanical properties are not much affected by small quantities of oxygen, and copper containing as much as 0.1 per cent. differs very slightly from pure copper. The electrical conductivity, which is usually profoundly affected by the addition of small quantities of an impurity to a pure metal, does not fall rapidly, and values exceeding 100 per cent. of the International Standard are obtained in all annealed materials containing less than 0.1 per cent. of oxygen. The relatively small effect of oxygen is without doubt due to the fact that the solubility of the oxide in solid copper is extremely low; so low, in fact, that for all practical purposes oxygen may be regarded as insoluble in solid copper. The oxygen-bearing metals must, therefore, be considered as a heterogeneous mixture of pure copper and finely-divided particles of cuprous oxide, and within the range of composition investigated the percentage of copper greatly exceeds that of cuprous oxide. The materials consist essentially of a soft ductile copper matrix, in which harder particles of cuprous oxide are distributed, and the properties of the series are such as would be expected from a mechanical mixture of such constituents.

These conclusions, however, are applicable strictly only to pure copper containing oxygen and free from other impurities. The effect of the simultaneous presence of other impurities may be very appreciable, and requires special investigation, for which the present report furnishes a necessary basis.

Train Lighting in Australia.—The Victorian Minister for Railways recently announced in Parliament that the lighting of 700 railway carriages (steam lines) was being converted from gas to electricity.—*Reuter's Trade Service.*

A British-built Electric Ship.—The official trials of *La Playa*, the first to be completed of three electrically-propelled vessels which are being built by Cammell, Laird & Co., Birkenhead, for the United Fruit Co., of Boston, Mass., have been carried out successfully. Specially built for the carriage of bananas in tropical zones, the vessel is 325 ft. long, and has a sea speed of 14 knots. Her propelling power is supplied by four generating sets, each consisting of a four-cylinder Cammell Laird Fullgar Diesel engine, running at 250 revolutions per minute, directly coupled to a generator supplying continuous current at 220 volts. The main generators are electrically coupled in series, and when in operation three, two, or one may be used at reduced powers if desired. The electrical propelling equipment has been supplied by the British Thomson-Houston Co., Rugby, and the wiring, switchboard, and auxiliary motors by the Sunderland Forge Co.—*Daily Telegraph.*

INSTITUTION NOTES.

Institution of Electrical Engineers.—The opening meeting of the session will take place on Thursday, October 18th, when Dr. Alexander Russell, M.A., D.Sc., will deliver his inaugural address as president. The premiums awarded for last session's papers will be presented on this occasion.

Iron and Steel Institute.—The annual meeting of the Institute has been held at the Chamber of Commerce at Milan, this week. Signor Falck, president of the Italian Association of Metal Industries, welcomed the guests in the name of Italy, expressing the hope that their meeting at Milan and their visits to factories in various Italian cities would give new strength to the old friendship which had existed between the two countries. Mr. Samuelson returned thanks, saying that he and his colleagues wished to study Italy also from the economic and social points of view, and affirming that Italy had always been a source of progress to civilisation. After discussing various reports presented to the meeting, the members visited the factories. The Chamber of Commerce gave a reception in their honour, and cordial toasts were exchanged. On Wednesday the members were to go to Como, after which they were to make a tour of Italy.—*Reuter's Trade Service* (Milan).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Rear-Admiral Sir Godfrey M. Paine, K.C.B., M.V.O., has been elected chairman of the Wellman Smith Owen Engineering Corporation, of London and Darlaston.

Captain J. Arthur Spencer, A.M.I.M.E., announces that he has now no connection with the business of Messrs. A. C. Alexandra & Co., Ltd., of Westminster.

The *Commonwealth Engineer* states that Mr. W. V. S. Wilton, of the Tasmanian Hydro-electric Department, has been selected as engineer to the Nymboida, N.S.W., hydro-electric scheme at a salary of £750 per annum; also that Mr. Benjamin Deakin, formerly general manager in Australia for the British Insulated Wire Co. and the Electric Supply Co. of Victoria, has returned to reside in Melbourne after having been in England for the past 15 years.

It is announced that Messrs. M. W. Jenkinson and W. L. Mathews have joined the board of Thomas Bolton & Sons, Ltd.

Mr. George Arrowsmith (M.Sc.Tech.) has joined the staff of Hick, Hargreaves & Co., Ltd., Bolton, as chief turbine designer and manager of their new steam turbine department. Mr Arrowsmith was previously chief assistant turbine designer to the English Electric Co., Ltd., at Rugby, for many years.

Capt. E. Murray Harvey, O.B.E., Commercial Secretary at Belgrade, will be in attendance at the Department of Overseas Trade on October 1st, 2nd and 3rd, for the purpose of interviewing manufacturers and merchants interested in trade with the Serb-Croat-Slovene Kingdom. Applications for appointments should be addressed to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1 (Reference 4937/T.G.).

Obituary.—Mr. J. H. Tritton.—We regret having to record the death of Mr. Joseph Herbert Tritton, the well-known banker, who was chairman for so many years of the Indo-European Telegraph Co., Ltd., and of Galletti's Wireless Telegraph and Telephone Co., and remained so to the last. He was in his 80th year.

Mr. F. L. Garstang.—We regret to record the death of Mr. Frank L. Garstang, station superintendent on the staff of Bolton electricity department. Mr. Garstang had been ill with chest trouble, and was recommended to take a trip to the Canary Islands. He had only been four days at sea when his trouble became acute, and he died on Saturday. He joined the Bolton electricity works staff in 1905.

Mr. H. P. Hussey.—The *Review of the River Plate* records the sudden death, on August 18th, while playing a foursome on the golf links at San Andrés, of Mr. Henry P .Hussey, superintendent of the All-America Cables, Inc. Mr. Hussey, who was a native of London, went to Buenos Aires fourteen years ago as assistant manager of the Central & South American Telegraph Co. Later he was made manager, a position which he held until 1918, when he was appointed superintendent. He was highly esteemed in both the British and the American communities in Buenos Aires.

Will.—The late Mr. Reginald Laurence, of Laurence, Scott and Co., Ltd., Norwich, left £148,918 gross and £141,690 net personalty.

NEW COMPANY REGISTERED.

Clayton-Murdoch Gas Appliances, Ltd. (192,387).—Registered September 8th. Capital, £75,000 in 60,000 preference shares of £1 each and 150,000 ordinary shares of 2s. each. To acquire from Todman, Ryall and Co., Ltd., (a) the benefit of a certain gas switch invention and appliance, and all or any of the British rights therein, (b) all or any of the British rights of manufacture of the "L.W." dynamo, and (c) all or any of the assets of the said company incident thereto; and to carry on the business of gas, electrical and mechanical engineers, &c. The subscribers (each with one preference share) are:—Brig.-Gen. F. E. Metcalfe, Bridge House, Waltham Abbey; J. C. Todman, 29, Goldsmith Avenue, Acton, engineer; J. P. J. Peregrine, 54, New Broad Street, E.C.2, merchant; J. Davidson, 54, New Broad Street, E.C.2, stockbroker; Florence E. Ball, 54, New Broad Street, E.C., secretary; R. Kennedy, 83, Addison Gardens, W., solicitor's manager; E. Salaman, 62, London Wall, E.C., solicitor. Minimum cash subscription, £7. No persons had consented to act as directors to September 7th. Qualification (except first directors), £100 shares or stock. Remuneration, £250 each per annum. Acting secretary: Florence E. Ball. Registered office: Capel House, New Broad Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Mills English & Co., Ltd.—Satisfaction to the extent of £1,000 on August 11th, 1906, and to the further extent of £1,000 on October 23rd, 1908, of "B" debentures dated November 23rd, 1904, securing £4,500. (Notices filed September 6th, 1923.)

English Electric Co., Ltd.—Trust deed dated August 14th, 1923, to secure £1,600,000 debenture stock, constituting a fixed and specific charge on freehold and leasehold hereditaments and a floating charge on the company's undertaking and property, present and future, including uncalled capital. Trustees: Anglo-American Debenture Corporation, Ltd., 3, Bank Buildings, Lothbury, E.C.

CITY NOTES.

East Anglian Electricity Co., Ltd.

The directors in their report for the year ended March 31st (as abstracted in the *Financier*) state that the profit, after making allowance for dividend on cumulative preference shares, amounts to £4,190, which they propose to allocate as follows:—Depreciation of freehold and leasehold land and buildings, plant, meters, mains, &c., £2,275, writing off agreement relating to Felixstowe Council Provisional Order, £359, carrying forward the balance of £1,562. The directors have utilised amounts standing to capital reserve account and general reserve account respectively at March 31st, 1922, in writing off assets as follows:—Goodwill, £5,000; cost relating to increase of capital, £4,998; preliminary expenses, &c., £2,333; depreciation, £725. They recommend that the dividend accrued to March 31st on amounts paid up on cumulative preference shares at rate of 7 per cent. per annum (less income tax) be declared.

Barcelona Traction, Light and Power Co., Ltd.

The report of the directors for the year 1922, of the combined undertakings of the Barcelona Traction, Light & Power Co. and its controlled companies shows that the revenue of the company increased from $2,065,537 in 1921 to $2,575,466 in 1922. Administration and general expenses and reorganisation and issue expenses, interest on 7 per cent. prior lien "A" bonds, 6 per cent. prior lien "B" bonds (payable in cash), 6 per cent. six-year bonds, 7 per cent. 30-year bonds, and service of 8 per cent. secured debentures, absorb $1,496,866, against $1,307,846, and there is a balance of revenue available for interest on first mortgage bonds of $738,359. The amount of interest paid on first mortgage bonds (being at the rate of 2 per cent. per annum) is $715,273.

The report of Mr. Fraser Lawton (which we summarise below) on the business of the operating companies in Spain is referred to by the directors. They state that except in shipping and metal industries business was good throughout the year in the Barcelona area, and in spite of increased cost building operations were very active in all quarters of the city. There was an increase of 9,027,870 pts. in the gross earnings of the combined enterprises of the companies operating in Spain over those for the year 1921, and in the net earnings an increase of 4,008,890 pts. As most of the bonds of this company are payable in dollars or sterling the rate of exchange with Spain is a matter of first importance. Since 1919 there has been a progressive movement in the wrong direction—the average monthly rate for 1920 was 23.32 pts. to the pound sterling, whereas for 1922 it was 28.65, representing a fall of 22.9 per cent. in the average value of the peseta. There were practically no rains in the autumn of 1922 and, as a result, the large reservoir at Tremp was not filled before the heavy winter load. It became necessary, therefore, to put the steam plant in operation from November to March, 1923. It is reasonable to hope that another "dry" year will not occur for a number of years, so that the operating companies will be saved the expense of steam operation for a long time to come. Considerable extensions were made to the Light and Power Co.'s distribution system during the year and further extensions are contemplated to meet the growing demand for power.

The operating results of the tramway company (Les Tramways de Barcelone) showed an increase in gross earnings of 7.69 per cent. and in net earnings 14.10 per cent. over those of the previous year. During the year a bus company secured a concession and began operations; the tramway company is also introducing 'buses on certain routes. Growing taxation continues to occupy the attention of the board. Quite recently a very heavy and quite unexpected impost was made upon the railway companies. This has been the subject of very active protest and negotiation, but as the companies have now appealed to the courts no comment can be made while the case is pending. The chief competitor of the Ebro Irrigation and Power Co. in Barcelona and the surrounding country is the Spanish company Energia Electrica de Cataluña, S.A., which sells approximately half as much power as is sold by the Ebro Co. Arrangements have recently been completed by which all the shares of the Energia company have been acquired by the Union Electrica de Cataluña, a Spanish company which has been organised under the auspices of the Ebro Irrigation and Power Co., Ltd., and this company. This new company will assume the direction of the power supply of both the Energia Co. and the Ebro Co., which should result in better service to the public as well as important economies for the companies, both in operation and in capital expenditure.

The directors' report is accompanied by a report by Mr. F. Fraser Lawton, managing director of the Ebro Irrigation and Power Co., Ltd., and the Ferrocarriles de Cataluña, S.A., in which he shows that the results for the year were as follows:

	1922. Pesetas.	Increase. Pesetas.	Per Cent.
Gross earnings ...	46,728,300.23	9,027,869.51	23.94
Operating expenses ...	18,694,073.37	5,018,979.69	36.70
Net receipts from operations	28,034,226.86	4,008,889.82	16.68

The increase in the number of kWh sold was 23 per cent., the average price in 1922 was exactly 17 centimos. The lighting expenses show a considerable increase, due to a large lay on renewals rendered expedient to insure against interruptions and to fortify the system in general in view of the rapid progress made, as reflected in the gross earnings.

The number of electric lighting customers increased from 3,432 to 115,518, and the power consumers from 10,968 to 13,730. The following table gives the particulars of steam and hydraulic generation :—

	1921. kWh. Generated.	1922. kWh. Generated.
Steam generation	32,470	4,904,190
Hydraulic generation—		
Pobla	3,916,650	5,006,430
Corbera	1,654,880	2,180,840
Serós	111,005,903	124,135,610
Tremp	65,071,172	64,950,809
Camarasa	56,705,160	77,949,782
Total	238,386,235	279,127,661
Power sold	177,452,923	219,084,146
Maximum monthly output at Serós was	14,132,600	13,117,800
Do. at Tremp	10,965,400	8,296,400
Do. at Camarasa	6,309,300	8,349,800

The storage reservoirs of the Ebro company are usually filled twice a year, in the spring and autumn. About once in seven years, however, the autumn rains fail or are very light. Such was the case in 1922, and as a result it was necessary to start the steam plants in November, in order to carry part of the power load, thereby reducing the amount drawn from the reservoirs. Conditions forced the company to continue the operation of the steam plants until the second week in March, 1923, and the resulting cost added very heavily to the operating expenses. Extensions and improvements to the properties (including the railway) chargeable to capital account absorbed 17,968 pts.; 5,152,054 pts. were reserved for depreciation in addition to the amount provided for amortisation of bonds of controlled companies. The materials in store and in transit on December 31st, 1922, stood at 5,626,638.62 pts., or a decrease of 1,222,579.33 pts. The Sabadell line of the railway was opened for public service on June 1st, 1922, and has exceeded expectations with regard to the revenue derived therefrom. The satisfactory increase in gross earnings was more than offset by increased operating costs.

Stock Exchange Notices.—The undermentioned have been agreed to be officially quoted :—

Barcelona Traction, Light and Power Co.—£50,000 8 per cent. secured debentures of £100 each (Nos. A7,001 to A7,500).

Charing Cross, West End, and City Electricity Supply Co.—16,000 ordinary shares of £5 each, fully paid (Nos. 80,001 to 96,000).

Tokyo Electric Light Co.—Scrip, fully paid, for £3,000,000 6 p.c. sterling bonds.

Bruce Peebles & Co., Ltd.—Dividend at the rate of 7½ per cent. per annum, less tax, on the 7½ per cent. cumulative participating preferences shares, for the half-year ended June.

Browett Lindley & Co., Ltd.—Dividend of 4 per cent. final, less tax, on the ordinary shares.

Electric Supply Corporation, Ltd.—Interim dividend at the rate of 7 per cent. per annum, less income tax, upon the ordinary shares for the half-year ending June 30th, as compared with 6 per cent. last year.

Prospectus.—*Ascot District Gas and Electricity Co.*—The company has recently made an issue of £15,000 six per cent. redeemable preference shares (£10 shares) at par.

British Aluminium Co., Ltd.—Dividends at the rate of 5 per cent. per annum, less tax, on the ordinary shares, and at the rate of 6 per cent. per annum, less tax, on the preference shares for the half-year ended June.

Shanghai Electric Construction Co., Ltd.—First interim dividend at the rate of 6 per cent. actual, less tax at the rate of 4s. 7½d. in the £.

STOCKS AND SHARES.

TUESDAY EVENING.

The clearing of the political horizon in Italy, as well as the lift in the clouds that have overhung the Ruhr district, are helpful factors for the assistance of Stock Exchange prices. Markets in most cases are firm. There is an accumulative disposition on the part of the public to invest money in stocks and shares, and, although business loiters in the matter of speculation, it must be admitted that animation is noticeable in a good many directions. The after-effect of the first news of the Japanese calamity was felt in various parts of the industrial area. Various shares in the iron and steel groups came into favour at rising prices, thanks to the expectation that big contracts would be placed with such companies in connection with reconstruction in the devastated cities. The strength of electricity supply shares continues unabated. The weakness of the Underground Electric Railway stocks has been little affected by a mild amount of profit-taking that occurred on the eve of the Stock Exchange settlement this week.

South London Electricity Supply shares are a good market at 1¼. Westminsters rose ¼ to 9½, Kensingtons 10s. to 9¾, and London Electrics ¼ to 4¼. Edmundsons gained another sixteenth at 3⅜. Bromptons hold their last week's rise. County of London ordinary reacted to 2 1/16. Charing Cross new ordinary now rank equally with the old. The market is a good one, and it may be of use to set out ordinary shares that are actually on offer. In the London list, a well-known Stock Exchange firm has the following shares for sale :—

200 Charing Cross	11 1/16
500 City of London	50/-
500 County Ordinary	42/-
250 London Electric	4 9/16
1,000 Metropolitan Electric	32/9

It must be added that, in these cases (unless the shares have already been taken), the sellers may possibly accept slightly lower prices when a buyer comes actually to deal. Outside these, there are also offered :—

£2,500 British Electric Traction ...	74¼
200 Calcutta Tramways (£5) ...	4¼
1,000 English Electric	17/6
1,000 Electric Supply Corporation ...	21/3
1,000 Llanelly and District	19/9
250 Madras Supply	23/-
1,000 Midland Counties	19/9
2,000 Scottish Power	23/6

Various of these shares are quoted in our own list, the prices there being the middle quotations which appear this (Tuesday) evening in the Stock Exchange Official List. When a market is good, as is the case with electricity supply shares, it is generally easier to sell at the middle prices than to buy at these levels.

The latest wireless scare, in connection with cable companies' stocks, has passed away, and prices in the Eastern group are all stronger. The effect of the newspaper attack, to which reference was made here earlier this month, was to disturb the minds of older-fashioned investors. Those who have followed the fortunes of the cable companies since wireless became a competitor, are too familiar with the conditions for the buyer to miss the opportunity of picking up cheap stock on any noticeable reaction. The earthquake brought into play the consideration that this terribly ill wind to Japan will blow benefit to the traffics of cable companies concerned with Far Eastern business, and this contributed to the ease with which the market recovered from its most recent attack of wireless nerves.

The Electric Supply Corporation has just raised its interim dividend from the rate of 6 per cent. to 7 per cent., and the price of the shares strengthened to 21s. 3d. in consequence. The manufacturing list is steady throughout. General Electrics are a shade harder. British Aluminiums hold their rise at 19s. 3d. British Insulated improved to 2¼, on the increase to 1s. per share, mentioned here last week, in the interim dividend. Of the cable shares, Henley's are better at 2 5/16. Telegraph Constructions have recovered their recent fall, and are again 25. Babcock & Wilcox, in the engineering group, reacted to 45s. 7½d.

British Columbia Electric deferred stock has been up to 100, another rise of 4½ points this week coming on top of the 6 points gain a week ago. This attracted sellers, and the price reacted to 98. The preferred stock is 4½ up at 86, though the preference at 86½ remains unchanged. Anglo-Argentine Tramways debenture stock is good at 74¼, showing a rise of 2. Brazilian Tractions reacted to 46. The Mexican group is the most disappointing in this particular department. Mexico has now obtained formal recognition from the United States, upon the strength of which expectation there have been, during the past few years, spasmodic spurts in the prices of Mexican utility issues, though these have been followed by falls. Now that the event has consummated, prices simply dwindle. No one seems to take any interest, and Mexican Light & Power first bonds are 1½ lower at 67.

The weakness in London & Suburban Traction preference, which has recently lowered the price to 9s., is ascribed to the unfavourable traffics produced by competition from pirate motor 'buses. These 'buses have been put on the road, naturally on the most paying routes and during the summer season, with the result that the tramway companies have suffered diminution in their receipts. There is no reason, however, why shareholders should become apprehensive, though, of course, with any share paying over 10 per cent. on the money, as these do, the risk is obvious.

In spite of the fact that business is not active, Underground Railway stocks hold their prices, and there is a fair amount of trade doing in Districts as well as in Metropolitans. When business is quiet, the usual consequence is for speculative prices to slip back, so that if there were to be a reaction in these two stocks, it would not be surprising. At the moment, however, the market continues very firm.

Amongst rubber shares, the tendency is to let prices drift by reason of a further set-back of a halfpenny or so in the raw product. In addition, the visible supplies are being increased week by week, owing, it is said, to the effect of the dockers' strike. Until these two influences, which, of course, act and react upon each other, take a more favourable turn, it can hardly be expected that rubber shares will recover.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Sep. 18, 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	2⅜	—	£5 18 3
Charing Cross Ordinary	5	9	14	11½	—	6 5 10
do. do. do. 4½ Pref.	5	4½	4½	4½	—	5 6 0
Chelsea	1	6	10	35/-	—	5 14 3
City of London	1	14	15	2½	—	6 1 0
do. do. 6 % Pref. ...	1	6	6	24/-	—	5 4 4
County of London	1	8	10	2⅛	—⅛	4 17 0
do. do. 6 % Pref. ...	1	6	6	23/3	—	5 3 3
Edmundson's Ordinary	3	Nil	7	3⅜	+ ⅛	6 4 5
do. 6 % Pref	5	12/-	6	4½	—	6 8 0
Kensington Ordinary	5	10	12	9½	+ ½	6 3 1
London Electric	3	4	10	4½	+ ⅛	6 18 4
do. do. 6 % Pref. ...	5	6	6	5⅜	—	5 11 7
Metropolitan	1	7	8½	14⅜	—	5 6 3
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	Nil	2½	17/-	—	2 18 10
do. 5 % Pref. ...	1	5	5	16/3	—	6 3 1
do. 7 % Pref. ...	1	7	7	23/6	—	5 19 2
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	Nil	—	15/-	—	Nil
do. 5 % Pref. ...	1	2½	5	3	—	6 17 0
St. James' and Pall Mall ...	5	12	14½	11⅞	—	6 3 5
South London	1	7	10	1⅝	+ ⅛	5 6 8
South Metropolitan Pref. ...	1	7	7	24/6	—	5 14 3
Westminster Ordinary	5	10	12	9⅜	+ ½	6 1 6
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/9	—	7 13 10

HOME RAILS.

Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	2½	3½	76	—	4 12 1
do. District	,,	1	3	54	—	5 11 1
Underground Electric Ordinary	10	Nil	Nil	3½	—	Nil
do. do. "A" ...	1	Nil	Nil	9/6	—	Nil
do. do. Income	Bonds	4	5	98	—	*5 2 0

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	102	+ ½	5 17 8
do. Def.	,,	1½	34/6	23	— ¼	6 9 0
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	17½	+ ⅜	5 14 3
Eastern Tel. Ord.	Stock	10	10	175½	+1	5 14 0
Globe Tel. and T. Ord.	10	10	10	17½	+ ⅜	5 14 3
do. do. Pref.	10	6	6	11⅜	+ ⅛	5 5 6
Great Northern Tel.	10	24	22	27½	—	8 1 6
Indo-European	25	10	7	32½	—	5 7 8
Marconi	1	25	15	2⅜	—	6 9 10
Oriental Telephone Ord. ...	1	12	12	1½	—	*6 3 9
United R. Plate Tel.	5	8	8	6⅞	+ ¼	*5 18 6
West India and Panama ...	10	Nil	Nil	1/6	—	Nil
Western Telegraph	10	10	10	17⅞	+ ¼	*5 15 1

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	3	—	9 3 4
do. do. 2nd Pref.	5	Nil	5½	2⅛	—	11 17 10
do. do. 5% Deb.	Stock	5	5	74½	+2	6 14 3
British Electric Traction Ord.	,,	4½	5	73½	—	6 16 1
do. do. 6 % Pref.	,,	6	6	100½	—	5 19 3
Brazil Tractions	100	Nil	4	46	—1/-	8 14 0
Brit. Columbia Elec. Rly. Pos.	Stock	5	5	86½	—	5 15 7
do. do. Preferred	,,	5	96/-	86	+4½	*5 12 0
do. do. Deferred	,,	3	127/-	98	+2½	*6 9 9
do. do. Deb. ...	,,	4½	4½	81½	—	5 4 4
Lond. & Sub. Trac. 5 % Pref.	1	3½	5	9/-	—	11 2 0
London United Tram. Deb. ...	Stock	4	4	60½	—	6 12 3
Mexico Trams. 5 % Bonds ...	—	Nil	Nil	75	—	6 13 4
do. 6 % Bonds ...	—	Nil	Nil	86½	—	Nil
Mexican Light Common ...	100	Nil	Nil	29	—	Nil
do. Pref.	100	Nil	Nil	56½	—	Nil
do. 1st Bonds ...	—	Nil	8	67	—1½	7 9 3

MANUFACTURING COMPANIES.

Babcock & Wilcox	1	15	20	2⅜	— ⅛	*4 10 1
British Aluminium Ord. ...	1	10	5	19/3	—	5 4 0
British Insulated Ord.	1	15	15	2½	+ ⅛	6 0 0
Callenders	1	15	15	2⅜	—	6 6 4
do. 6½ Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	⅝	—	8 17 6
Edison-Swan	1	10	Nil	5/-	—	Nil
do. do. 5% Deb.	Stock	5	5	65	—	7 13 10
Electric Construction	1	10	10	1½	—	6 16 1
English Electric	1	8	5	17/3	—	5 16 0
do. do. Pref.	1	6	6	19/6	—	6 3 0
Gen. Elec. Pref.	1	6½	6½	22/9	—	5 14 3
do. Ord.	1	10	5	18/9	+3d.	5 6 8
Henley	1	15	15	2⅞	+ ⅛	6 9 10
do. 4½ Pref.	5	4½	4½	4⅜	—	5 2 10
India-Rubber	1	10	—	11/3	—	—
Met.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	⅞	—	Nil
Telegraph Con.	12	20	20	25	+ ½	*5 0 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only genera and they may vary according to quantities and other circumstance

CHEMICALS, &c.	Price Sept. 19th.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6½d.	½d. inc.
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£25	£2 dec.
a Copper Sulphate ... ... ,,	£25 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	4d.	...
a Shellac ... ... per cwt.	£14 10s.	£1 inc.
a Sulphur, Sublimed Flowers ... ,,	£8 10s.	...
a ,, Roll ... ... ,,	£8	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 10s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£115 to £120	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/8 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£185	...
Grade II ... ... ,, ,,	£131	...
Grade III... ... ... ,, ,,	£73	...
c Brass (rolled metal 2" to 12" basis) per lb.	10d.	...
c ,, Tubes (solid drawn) ... ,,	1/0 to 1/0½	...
c ,, Wire, basis ... ... ,,	10½d.	...
c Copper Tubes (solid drawn) ... ,,	1/1½d.	...
c ,, Bars (best selected) ... per ton	£96	...
c ,, Sheet ... ... ,,	£96	...
c ,, Rod ... ... ,,	£96	...
d ,, (Electrolytic) Bars ... ,,	£68 5s.	£2/- dec.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£78 5s.	£2/- dec.
d ,, ,, H.C. Wire per lb.	9½d.	¼d. dec.
f Ebonite Rod ... ... ,,	8/6	...
f ,, Sheet ... ... ,,	8/-	...
n German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	6/6	...
h India-rubber, Para fine ... ... ,,	1/3	...
f Iron Pig (Cleveland Warrants) ... per ton	£5 2s. to £5 2s. 6d.	...
f ,, Wire, galv. No. 8, P.O. qual. ,,	£25	...
g Lead, English Pig ... ... ,,	£26 15s.	5s. dec.
g Mercury ... ... per bot.	£8 15s.	...
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium... ,,	4/- to 6/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings	1/3	...
p ,, drawn bars and rods	1/3½	...
p ,, rolled strip & sheet	1/3½	...
p ,, wire	1/3½	...
o Platinum ... ... per oz.	£25	...
d Silicium Bronze Wire ... ... per lb.	1/1	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton	£199 to £199 5s.	...
n ,, Wire, Nos. 1 to 16 ... ... per lb.	2/-	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
j Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Radio-controlled Motor Transport.—An interesting d scription of a recently-conducted practical demonstration the way in which a vehicle can be controlled from hea quarters while it is out on the open road and without tangib means of interconnection was published in the *Commerci Motor*. This development opens up several possibilities, fo in addition to a repair-shop keeping in touch with mobi vans on the road, it would be extremely useful if the vehicl employed by a parcel collecting and delivery agency cou receive messages from headquarters while they were on t road.

This installation has been erected by the Park Motor C Ltd., for employment in connection with its breakdown va The vehicle is equipped with receiving apparatus, and t garage has its transmitting plant, so that while the vehi is away from headquarters its driver can still receive messag and instructions.

Messages were very clearly received both on a Western Ele tric loud speaker (with power amplifier) and on two pairs head-phones (using one h.f., one detector, and one l.f. va only). The demonstration was in every way satisfactory a proved that it certainly is practicable to maintain communic tion between a moving vehicle and its headquarters.

The two-Osram-valved choke-controlled transmitter w worked off "Ever-Ready" dry batteries. The actual circu was built up from parts obtained from Messrs. Gambrell Bro The pressure employed is about 1,000 volts, and the batter stand up remarkably well to their work. The aerial current carried to a single-wire T-aerial above the garage. T receiving set employs a movable aerial mounted on top the van and made up of four copper strips slung by insulat between two poles. The receiving panels were supplied b Messrs. Gambrell Bros., and incorporate four valves.

THE STUDY OF POWER-STATION EFFICIENCIES.

By C. W. MARSHALL.

It must be obvious to everyone who is following the electrical engineering Press with any degree of thoroughness that the subject of thermal power-station efficiencies is probably having more attention paid to it than any other at the present time. With a view to improving the efficiencies of their stations, engineers are studying such questions as the application of powdered coal fuel, the use of air preheaters in addition to or instead of the conventional fuel economiser, turbine bleeding for feed-water heating, the utilisation of waste heat from alternators, and so forth. The conventional method of dealing with these matters is to work with practically any handy unit, such as pounds of coal per kWh or B.th.u. per kWh when considering overall efficiencies of stations, to take the temperature of the gases leaving the economiser or air heater as a guide to the efficiency of boiler units, to rate boilers as capable of evaporating so many lb. of steam per hour, and stokers as having so many square feet of grate area. The amount of labour spent by engineers in making calculations on these different points is enormous, and it is generally only after considerable trouble that published statistics regarding power stations can be reduced to a common basis. The whole trouble is, of course, only a particular case of the general chaos caused in this country by the use of British units instead of metric units, but pending the adoption of a sound general system the present writer proposes that the use of the kW and kWh should be extended as outlined below. Any unit of energy and power, such as the B.th.u. and B.th.u./hour could be used, but as the kWh and kW are the standards for the sale of electrical energy, their use is obviously preferable to electrical engineers at least.

The scheme proposed will be illustrated by considering the principal items of power plant in a modern thermo-electric power station using boilers and turbo-alternators, starting from the electrical end and working back to the fuel supply.

The gross output of the station is, of course, always measured in kWh and the rate of working in kW. The net output, which is the gross output minus the energy expended in driving the auxiliary services of the station, is more difficult to determine, especially where steam-driven auxiliaries are used. The auxiliary loss is, however, a small fraction of the gross output, say, from 3 to 10 per cent., so that a comparatively large percentage error in measuring this loss can be made without making a serious error in the net output. The electrical items can obviously be measured directly by watt-hour meters, but the steam items can usually only be estimated from the steam flow, and the energy contents of the steam at inlet and exit conditions. It is at present impossible to make use of permanent measuring instruments for such purposes owing to their high cost, but the use of portable steam-flow meters to determine the kW input to steam-driven auxiliaries is well worth consideration.

Alternator Losses.

With the ordinary cooling system, it is necessary to measure the air flow and its temperature rise to get the kW loss in an alternator, and as the air flow is very variable, the measurements have to be made very carefully to get results of much value. The modern "closed system" of cooling has made matters much easier as the rate of flow of the cooling water is very constant, so that its temperature rise gives a direct measurement of the loss. A differential thermometer giving the temperature rise of the cooling water can generally be calibrated to read the alternator loss in kW directly.

Turbine Input.

It is customary to measure the input to each turbine in pounds of steam or water per hour by means of a steam- or water-flow meter, but it would be a simple

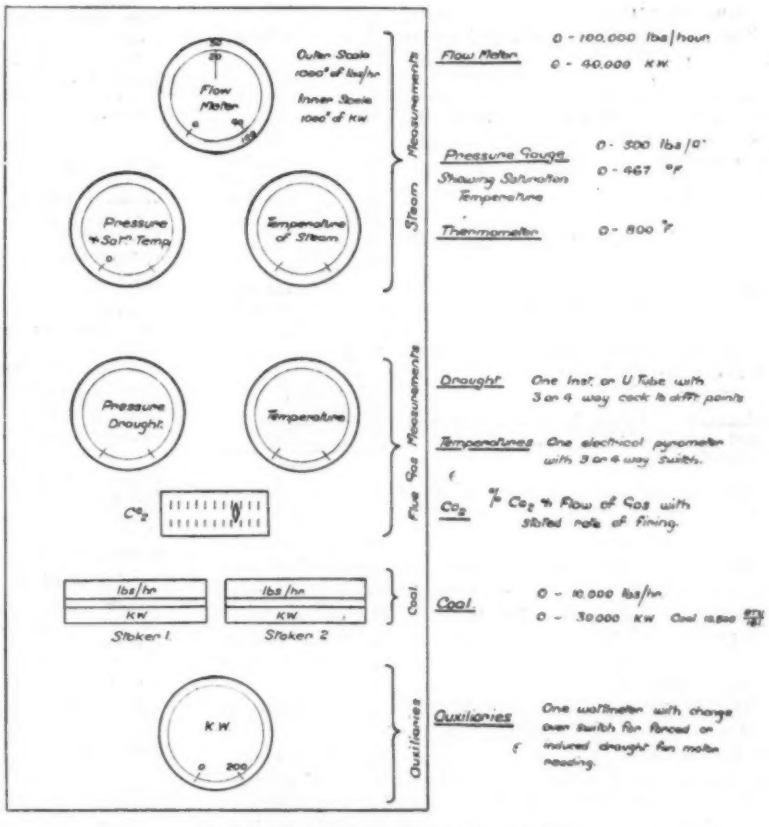

Flow Meter
Outer Scale 1000's of lbs/hr
Inner Scale 1000's of KW
Pressure & Sat. Temp.
Temperature of Steam
Steam Measurements
Pressure Draught
Temperature
Flue Gas Measurements
Stoker 1
Stoker 2
Coal
KW
Auxiliaries
Flow Meter 0 - 100,000 lbs/hour 0 - 40,000 KW
Pressure Gauge 0 - 300 lbs/0"
Shewing Saturation Temperature 0 - 467 °F
Thermometer 0 - 800 °F
Draught One Inst. or U Tube with 3 or 4 way cock & diff. points
Temperatures One electrical pyrometer with 3 or 4 way Switch.
Co2 % Co2 & Flow of Gas with stated rate of firing.
Coal 0 - 10,000 lbs/hr 0 - 30000 KW
Auxiliaries One wattmeter with change over switch for forced or induced draught fan motor reading.

FIG. 1.—BOILER INSTRUMENT EQUIPMENT.

matter to calibrate such an instrument in kW (and kWh if of the integrating type) from the known energy content of the ingoing steam. The rate at which energy is being returned to the boiler in the condensate could also be expressed in the same way.

Condenser Losses.

The loss of heat to the condensing water is readily determined by a heat balance, and at constant flow the temperature rise in the circulating water gives a direct measure of the loss, and can be expressed in kilowatts.

Boilers.

It is now standard practice (in large power stations) to fit steam-flow meters on all boilers, and since the temperature and pressure of the steam are approximately constant, it is a simple matter to provide the flow meters with a kilowatt scale.

Fuel.

The rate of combustion and total coal burnt in chain-grate stokers is easily determined from the grate dimensions speed and fire thickness, and the Lea coal meter has been very fully developed for giving these figures directly. Here, again, kW and kWh scales are easily made if the calorific value of the fuel is known. Where gas, oil, or pulverised coal are used, this measurement is even simpler.

The "chimney" losses can be determined from the total gas flow and temperature at exit, and when the gas flow is constant, the temperature alone gives an approximation to the losses in kW. Other important items, such as the relative powers of boiler, superheater, economiser, and air heater, can be dealt with in a similar way.

The proposed system will now be illustrated by a simple example, the figures being typical of fairly modern power-station practice. One turbo-alternator of 20,000-kW capacity is supplied by, say, four boilers, with superheaters and economisers. Each boiler has two chain-grate stokers. Electrically-driven auxiliaries are used throughout. For the sake of simplicity, it is assumed that there is no feed-heating system.

The running figures at full load would be as follows:

RATING.

Plant Unit.	Present system.	Electrical system.	
Alternator	20,000 kW	20,000 kW	
Coolers for alternator and bearings of complete set.	Gallons per hour	1,000 kW	Read directly on outlet thermometer if inlet temp. and quantity of cooling water and constant.
Turbine	200,000 lb./hour	26,500 kW	(lb./hr. × heat drop)/3,415.
Condenser	26,000 ft.² and 22,500 gal./min.	58,000 kW	lb. of steam condensed × heat/lb. / 3,415.
Boilers (4) (Total output)	200,000 lb./hr. at 275 lb./in.² and 700° F.	85,000 kW	lb. of steam generated × heat/lb. / 3,415.
Stokers (8) (Total capacity)	Square ft. each. 40,000 lb./hour.	106,000 kW	lb. of coal/hr. × B.th.u./lb. / 3,415.

The instrument equipment on the boilers would then fall into line with that on the alternators, and might be somewhat as shown on fig. 1. The instruments would have double scales to suit both mechanical and electrical engineers. Centigrade scales should be used as well as Fahrenheit. The figures given are only for the purpose of illustrating the system of units recommended, and are not to be taken as really representative of any actual station.

The advantage claimed for this method of working is that an energy or power balance for a power station, or for any part of it, could be made up directly from the instrument readings with the minimum of calculation. It would also make it much easier for beginners in power-station work to see where possible savings could be effected and the relative importance of the various losses in a station.

UNITED STATES EXPORTS.

Electrical Machinery and Apparatus.

Below are shown the values of electrical machinery and apparatus exported from the United States during the twelve months ended June last. In order to give comparative figures as far as they are available, the values for half of 1922 or, where possible, those for the twelve months ending June, 1922, are also stated. Owing to alterations in classification an exact comparison cannot always be made:

	Jan. 1st to June 30th, 1922.	12 months ended June, 1923.
Direct-current generators.—	$	$
Under 500 kilowatts	263,600	716,700
500 kilowatts and over	394,000	1,119,000
Alternating-current generators.—		
Under 2,000 kilowatts	97,200	179,500
2,000 kilowatts and over	404,300	1,671,000
Accessories and parts of generators	737,000	706,000
Self-contained lighting outfits	196,000	600,000
Batteries.—		
Primary	580,000	1,168,000
Wet	—	—
Storage	654,000	2,045,000
Transforming or converting apparatus.—		
Power transformers	2,207,000	3,438,000
Other transformers	470,000	631,000
Rectifiers, condensers, double current and motor generators, dynamotors, synchronous and other converters	645,000	1,238,000
Transmission and distribution apparatus.—		
Switchboard panels, except telephone	1,003,000	2,475,000
Switches and circuit breakers over 10 amps.	983,000	1,898,000
Fuses and fuse plugs	83,000	254,000
Watt-hour and other measuring meters	358,000	429,000
Volt, watt, and ampere meters, and other recording, indicating, and testing apparatus	394,000	945,000
Lightning arresters, choke coils, reactors, and other protective devices	338,000	600,000
Motors, starters and controllers.—		
Motors, under 1 h.p.	333,000	1,421,000
Stationary motors.—		
1 to 200 h.p.	1,074,000	2,363,000
Over 200 h.p.	343,000	578,000
Railway motors	28,000	552,000
Electric locomotives.—		
Railway	22,000	2,758,000
Mining and industrial	145,000	210,000
Other motors	4,857,000	196,000
Rheostats, controllers, and other starting and controlling equipment	715,000	1,295,000
Accessories and parts for motors	605,000	1,208,000
Electric lamps.—		
Carbon filament	61,000	59,000
Metal filament	1,286,000	1,168,000
Other electric lamps	97,000	224,000
Flashlights	103,000	394,000
Searchlights and projectors	88,000	337,000
Motor-driven household devices	287,000	807,000
Electrical appliances.—		
Electric fans	676,000	831,000
Industrial electric furnaces and ovens	117,000	196,000
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries	277,000	725,000
Signal and communication devices.—		
Radio and wireless apparatus	1,165,000	2,945,000
Telegraph apparatus	124,000	732,000
Telephones	—	—
Telephone apparatus, including telephone switchboards	2,465,000	(a) 1,926,000
Railway signals, switches, and attachments	216,000	750,000
Bells, buzzers, and annunciators	26,000	91,000
Other electrical apparatus.—		
Spark plugs, magnetos, and other ignition apparatus	(b) 953,000	1,196,000
Insulating material	399,000	1,186,000
Metal conduit, outlet, and switch boxes	163,000	355,000
Sockets, lighting switches and receptacles	132,000	919,000
Other wiring supplies and fixtures	(b) 999,000	1,738,000
Other electrical apparatus, n.e.s.	(b) 15,570,000	6,941,000

(a) July 1st to December 31st, 1922. (b) Twelve months.

Bauxite in Hungary.—The deposits of bauxite which were discovered in Hungary some time ago are stated to be so extensive that producers recently asked the Government for permission to export the metal. The Tariff Commission which is engaged upon the preparation of a new tariff has rejected the application on the ground that the Government does not desire the export of bauxite or of that of any raw materials.

THE BRITISH ASSOCIATION—II.

A large assembly filled the Philharmonic Hall on the evening of September 12th, including many distinguished foreign scientists.

The Lord Mayor (Mr. Frank C. Wilson) and Dr. Adami, Vice-Chancellor of the University, expressed their gratification in the choice of Liverpool as the *venue* of the Association's 91st meeting, and welcomed the members to the City.

Sir C. S. Sherrington, the retiring President, replied on behalf of the Association, and introduced his successor, Sir Ernest Rutherford, F.R.S., who then delivered his address, which was abstracted in our last issue. At the conclusion of the address, Sir Oliver Lodge, F.R.S., in his habitual easy manner, proposed a vote of thanks to the President, and in seconding this, Dr. E. H. Griffiths, general treasurer of the B.A., mentioned that more than 3,000 members and guests were present for the meeting.

The very full programme commenced on Thursday morning (13th), two of the most important meetings being devoted to joint discussions by two or more sections. Sections A—Mathematics and Physics, B—Chemistry, and G—Engineering met to discuss "Cohesion and Molecular Forces," of which a brief summary will be given later. Sections F—Economics and J—Psychology dealt with "The Interconnections between Economics and Psychology in Industry," a subject which, while of a rather "intangible" nature, was shown to be of more importance than was often realised. An important point raised was the effect of the sympathetic treatment of workers—welfare work—upon production. Many well-known psychologists and economists participated in the discussion. Mr. Eric Farmer stated that there was little doubt that as the study of industrial psychology progressed, definite laws would be established which would tend to make the knowledge of the factors governing production more accurate than it was at present.

On the same morning the members in Section A listened to two papers upon the scattering and absorption of X-rays by Professors Darwin and Barkla respectively. These were of a highly speculative nature, the first dealing with a series of experiments carried out by Prof. A. H. Compton, the American physicist, which showed that the wave-lengths of deflected X-rays altered according to the angle of deflection, the alteration being given as $.022\ (1-\cos\theta)$ Angstrom units, where θ was the angle of deflection.

On Thursday afternoon, Sections G and J met to compare views on "Vocational Tests for Engineering Trades": a number of the main points raised are noted in an abstract of the discussion which will appear in a later issue.

Five of the presidents of sections delivered their addresses on Thursday. Dr. Vaughan Cornish, president of Section E—Geography, took as his subject "The Geographical Position of the British Empire," which dealt with the racial, strategic, and economic aspects. Speaking of the ability of this country to support its ever-growing population, Dr. Cornish took an optimistic view. He stated that the commercial position of Great Britain was more favourable than that of any other country of equal size, and the large amount of good coal, besides iron ore and beds of salt, enabled full advantage to be taken of the geographical position in manufacturing for export. Moreover, no change in the distribution of available minerals could ever do away with the commercial advantage conferred by our central and focal position on the natural maritime routes. Hence the population which could be supported in Great Britain depended upon services to outside nations to a much greater extent than in most countries, and our prosperity depended upon that of the rest of the world.

A number of general and sectional excursions were made in the afternoon. Section A went to the works of the Automatic Telephone Manufacturing Co., Ltd., at Edge Lane. The works cover an area of 46,000 sq. yd., and find employment for 1,500 persons. The party went through the tool room, machine department, apparatus assembly departments, the plating and finishing shops, &c., and also saw the manufacture of domestic heating and cooking appliances and radio apparatus. Section B visited the works of the United Alkali Co., Ltd., and Sections E and F were conducted over the docks, tea being provided by the Mersey Docks and Harbour Board.

On Thursday evening the Lord Mayor and Lady Mayoress were "at home" at the Library, Museum, and Walker Art Gallery, from 8.30 to 11 p.m., and the ample space available was severely taxed by the number of members who were present at the reception.

The handbook issued this year is a treatise upon "Merseyside" generally, and has been edited by Dr. Alfred Holt, M.A. The City Engineer of Liverpool, Mr. J. A. Brodie, contributes an article upon engineering development in the city, and Messrs. H. Dickinson (City Electrical Engineer) and P. Priestly (General Manager of the Corporation Tramways) deal with their respective undertakings in a brief but interesting manner. Many other features of the city and its immediate surroundings are treated by writers possessing an intimate knowledge of their subjects.

One of the principal items in Friday's proceedings was the symposium and discussion upon transport matters in Section G, a review of which we hope to give in our next issue. This occupied the whole morning, the members having the choice of three visits in the afternoon, *viz.*, the s.s. *Franconia* (Cunard Line), the Lister Drive power station, and the shipyards of Messrs. Cammell Laird & Co. at Birkenhead.

In Section F, Prof. Henry Clay read a paper on "Post-War Wages Problems." The speaker stated that the inter-relation of wages in the different industries had been dislocated by the war, and the main need was the restoration of this stability. Several factors had to be taken into account, such as the changes in the distribution of workers among different occupations; changes in the organisation of wage earners; changes in the character of the work required; and changes in the markets of British industries. It was considered that the average level of wages in export industries would have to be taken as a basis rather than the present pre-war level standard.

The afternoon proceedings of Section A included a series of very interesting experiments by Mr. W. M. Mordey with alternating magnetism, and these were followed by a demonstration of the "Frenophone" (a friction-operated loud speaker) by Mr. S. G. Brown.

The presidential address by Prof. J. C. McLennan, F.R.S., on "The Origin of Spectra" in Section A on Monday, September 17th, was followed by a paper by Prof. N. Bohr on "The Correspondence Principle." These subjects, of course, have only very indirect interest for our readers, in so far as they relate to the constitution of matter, and there they must be left. Other papers dealt with in Section A were "The Structure of Atoms and their Magnetic Properties," by Prof. P. Langevin, and "The Effects of Weak Magnetic Fields on the Polarisation of Resonance Radiation," by Prof. R. W. Wood and Dr. A. Ellett.

There was an interesting morning in Section G—Engineering, the first paper to be noted being one by Capt. J. A. Slee, of the Marconi International Marine Communication Co., which discussed recent developments in the application of wireless telegraphy to the mercantile marine. An interesting part of this paper was the description of the revolving beam station, which we refer to in detail and illustrate in this issue. These stations transmit a wireless signal on an exceedingly short wave—about six metres—in the form of a fairly

concentrated beam, and the whole apparatus of the transmitter can be rotated bodily on a turntable.

After a paper on the development of the single-bucket elevator, there was a paper by Mr. J. B. C. Kershaw, who discussed the new Smoke Abatement Bill in particular and the smoke problem in general. Another paper in Section G was "Analytical and Experimental Investigations relating to Water Turbines," by Dr. Hubert Mawson, which was largely of a mathematical character, though none the less valuable on that account as a contribution to the practical side.

A preliminary announcement by the Council with regard to next year's meeting in Toronto, stated that it would be held from September 3rd to 10th inclusive under the presidency of Major-General Sir David Bruce, K.C.B., F.R.S. For those of affluence, an attractive programme is contemplated, costing some £120 or more, which includes a trip across Canada to Vancouver before the actual commencement of the meeting. A sum of money has been generously promised by the Canadian authorities to be at the disposal of a committee of the Council of the Association for distribution in grants toward the expenses of the visit for selected members taking official or other active part in the proceedings of the meeting.

Triple-Frequency Currents in Earth Return Circuits.

By PROF. E. W. MARCHANT, D.SC.

(Paper read before Section G—Engineering.)

IT is often found in large central stations that a current flows through the earth lead to the neutral of the three-phase generators. It is well known that when the neutrals of a number of three-phase machines are connected together, large circulating currents will flow through the neutral connections of the machines. This phenomenon was described in some detail in a paper published by Mr. Catterson Smith and the author in the *Electrician*.* It is now common practice to earth only one neutral in a generating station, but recently it

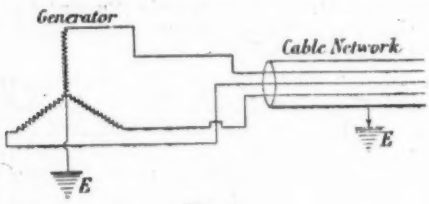


FIG. 1.

has been observed that even when this is done there may still be a comparatively large current flowing through the neutral. One or two cases of this kind have come to the author's notice, and it may be of interest to describe the results of the observations and tests that have been made and to explain the phenomenon. In one case of a large system, a current of nearly 40 A was observed when the neutral of a machine, recently installed, was earthed. It had further been noticed that the amount of this current depended on the size of the cable network that was connected to the station, *i.e.*, when part of the cable network was disconnected, the current flowing was reduced. It was surmised, at first, that the current was due to leakage, but an examination of the wave shape of

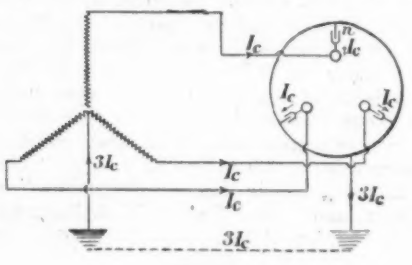


FIG. 2.

the neutral current showed that it was a capacity current flowing through the cable. Most of the high-pressure transmission systems that have been laid in this country consist of three-core cables with the sheaths earthed. A diagrammatic representation of such a network is shown in fig. 1.

The capacity currents flowing through the cables in the system due to the three-phase pressure applied give no resultant current through the sheath, or whatever conductor is used as a neutral. But if there is a triple-frequency component in the wave of pressure between phase and neutral, a triple-frequency capacity current will flow, and the three currents in the three phases will produce a resultant triple-frequency current through the earth return. This current will flow as shown in the diagram, fig. 2. The three currents will flow to ground from the sheath of the cables, and if the neutral of the generators is earthed, the current will return through the earthing resistance. Examples of the currents observed through the earthing resistance are given in figs. 3 and 4. It will be noticed in figs. 4*a* and 4*b* that the current flowing has a complex wave shape, a relatively strong 15 times frequency component being present. This current is due to a tooth ripple in the wave shape of the alternator, and is not usually very large. The magnitude of the triple-frequency current flowing is not greatly affected by the value of the earthing resistance, since the reactance due to the capacity of the cables is usually high. For a network of 60 miles of high-pressure cable, the effective reactance will be about 50

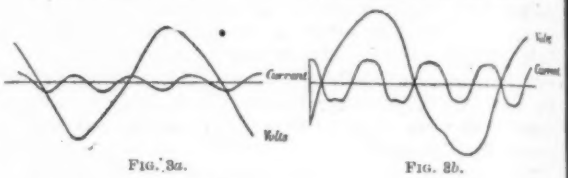


FIG. 3*a*. FIG. 3*b*.

FIG. 3A.—VOLTS BETWEEN PHASE AND CURRENT THROUGH NEUTRAL OF 3,000-KW ALTERNATOR (3 PH.) R.M.S. VOLTS 3,800, R.M.S. CURRENT 5 AMPS.

FIG. 3B.—VOLTS BETWEEN PHASE AND CURRENT THROUGH NEUTRAL OF 12,000-KW ALTERNATOR (3 PH.) R.M.S. VOLTS 3,500, R.M.S. CURRENT 33 AMPS.

ohms for triple-frequency current at 150 cycles per second, and an earthing resistance of 4 ohms or 5 ohms more comparable with the values of earth resistance ordinarily used. The increase in the higher frequency harmonics produced by short-circuiting the earthing resistance is shown in fig. 4*b*.

If the neutral of the alternator is not earthed, there is clearly no return circuit for these currents, and the voltage of the neutral of the alternators will have a triple-frequency pressure (measured to earth), equal to the triple-frequency component of the pressure wave. In this case no triple-frequency currents will flow to earth through the cable sheath, as the pressure difference between the cable cores and the earthed sheath will have no triple-frequency component. This condition, however, does not usually exist in practice. These earth currents do not do much harm as far as the central station itself is concerned, and it is therefore, as a rule, not necessary to get rid of them, except in special cases. When it becomes necessary to reduce them, either the alternators must be rebuilt so as to give no triple-frequency components of e.m.f. in their phase pressures, or else some device, similar to that described in the paper read by Mr. Turney and the author before this Section, must be used. The author mentions the assistance afforded by Messrs. Crompton Ramsay and Young in taking oscillograph records and in analysing the curves.

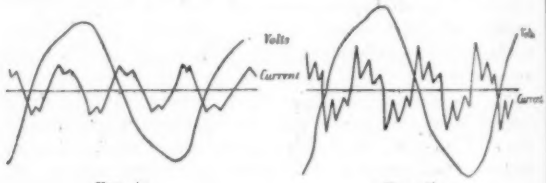


FIG. 4*a*. FIG. 4*b*.

FIG. 4A.—VOLTS BETWEEN PHASE AND CURRENT THROUGH NEUTRAL OF 3,500-KW ALTERNATORS (3 PH.) R.M.S. VOLTS 3,500, R.M.S. CURRENT 9 AMPS.

FIG. 4B.—VOLTS BETWEEN PHASE AND CURRENT THROUGH NEUTRAL OF 3,500-KW ALTERNATOR (3 PH.) R.M.S. VOLTS 3,500, R.M.S. CURRENT 13 AMPS. EARTHING RESISTANCE SHORT-CIRCUITED.

Electric Ship Propulsion.

By F. H. CLOUGH, C.B.E.

(Abstract of paper read before Section G—Engineering).

ALTHOUGH the reciprocating steam engine is in many respects excellent for marine propulsion, the best speed for any given power being closely the same as for the propeller, and no intermediate gearing being necessary, the reason why this type of engine is being placed to-day is, first, that for the largest sizes of ships the reciprocating steam engine becomes too large to be practicable, and secondly, the fuel consumption is higher than is required for steam turbines or for Diesel engines.

In the steam turbine, the flow of steam is continuous

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through the turbine, and parts are therefore not subject to alternating temperatures; also the highest vacuum can be readily utilised, and further, superheated steam can be used. For these reasons, the fuel consumption for steam turbines is considerably lower than for reciprocating engines, but in order to obtain these results, the steam turbine has to run at a very high rotational speed, and consequently some form of mechanism must be instituted between the turbine shaft and the propeller shaft to reduce the rotational speed.

The Diesel engine, although rather clumsy, has a very high thermo-dynamic efficiency. The engine has to be very heavy for the power developed, and most modern engines run at a comparatively low speed. It is suitable for directly coupling to the screw, but it is not self-starting, and starting and reversing have to be carried out by means of compressed air contained in steel bottles. With the possibility of electrical transmission from the engine to the propeller shaft, it would be desirable to design engines to run at high speed, and this should be feasible, as the reciprocating parts being already made to withstand very high compression should be amply strong to withstand high inertia stresses. By suitably proportioning the length of stroke and connecting rod, the reciprocating inertia stresses can be made largely to cancel out the compressive stresses.

Gearing between the turbine and propeller shaft is the usual form of propelling machinery to-day. For the larger ships it is sufficient to use a single-speed reduction, but for some of the smaller equipments the best speeds for propeller and turbine necessitate a reduction ratio of about 40-1, and in this case double-reduction gearing is necessary.

The electrical transmission of power would seem a round-about way at first sight, but the weight and size of machinery required does not differ greatly from gearing, and it has many distinct advantages. In an electric motor the tangential force causing rotation is magnetism, which acts much in the same way that gravity does, that is, invisible, and without any apparent means for conveying the force.

The rotor of an electric motor has this force acting on it; although mechanically it is perfectly free and not touching anything, the electric currents in the conductors of the stator which surrounds the rotor give rise to magnetism, which rotates, and in rotating draws the rotor with it. It can readily be seen with this arrangement that there is no mechanical wear, and an electric motor does not wear out.

Assuming that an electric motor has a rotational force of 3 lb. on each square inch of the rotor surface, and that a gear wheel has a rotational force of 600 lb. on each linear inch of face, a comparison of size can be made. For the purpose an example will serve, and it will be assumed that 3,000 h.p. is required to drive a propeller shaft at 100 r.p.m. The torsional force corresponding to 3,000 h.p. at 100 r.p.m. is 1.9 million inch-lb. If d and l are respectively the diameter and length of the gear wheel or electrical rotor, then for the gear wheel the torque or torsional force will be $600 \times d/2 \times l = 300\,dl$, and for the motor the force will be $\pi\,dl \times d/2 \times 3 = 4.7d^2l$. A suitable diameter for an electric motor of this capacity is 130 in. For this diameter the length from the above expressions will be 24 in. for the electric motor and 49 in. for the gear wheel. It will be seen that for this diameter the electric motor is smaller than the gear wheel. If two pinions are fitted to the gear wheel, its length will be halved, but two pinions mean either two turbines—an expensive and not very efficient arrangement for an equipment of this size—or else a double intermediate wheel—an arrangement in which it is difficult to ensure that the pinions share the load equally. Further, the diameter of the gear wheel would probably be reduced somewhat with a corresponding increase in length. The example shows, however, that electric motors can be made comparable in size with gear wheels.

The method of control and reversal of electrical-propulsion equipment is as follows:—The steam turbine is fitted with a governor, by means of which the speed can be varied over a wide range. For starting up, the governor is set to run the turbine at slow speed, about 20 per cent. of normal. The main switches between the motor and alternator are closed and the motor and alternator are then excited. Finally, the speed of the turbine is increased to full value, and the motor speed increased correspondingly. If the ship is running at full speed ahead, and it is required to reverse it, the governor is set for low-speed running, the excitation is taken off, the main switches are thrown over, the excitation is re-established, and the governor is again put to full-speed setting.

The efficiency of electrical transmission is very closely the same as that of double-reduction gearing. In a paper read by Mr. W. J. Belsey before the Institution of Engineers and Shipbuilders in Scotland, he worked out some examples, in which he showed that the losses on turbo-electric equipment were 8.2 per cent., on double-reduction gearing 10 per cent., and on single-reduction gearing 8 per cent. From the efficiency point of view there are advantages in the electrical equipment which cannot be obtained with the gearing. In general, a single turbine can be used instead of two, which saves a considerable amount of loss in the glands, piping, &c. Much higher superheat can be used, which becomes impossible with the geared turbine on account of the reversing blades, and, finally, the loss associated with the reversing blading is eliminated.

Apart from the bearings which, of course, can be oil-film lubricated, there are no wearing parts in the electrical equipment, and, provided the equipment is properly designed, it should have an almost indefinite life.

Should repairs be necessary, they can readily be carried out, and generally a repair will consist in replacing some of the electrical conductors on which the insulation may have become damaged. This is comparatively a simple matter, and can be carried out easily; in fact, in most cases such repairs can wait until the ship reaches port.

In naval vessels it is often desirable to run at full power or at cruising speed. With electrical transmission this can be carried out by arranging that the motor shall have two sets of poles, which is equivalent to changing the gear ratio. The turbines can be run at full speed when the ship is travelling at a reduced speed, and as the power is very much lower at the reduced speed of the ship, some of the turbines may be shut down. This gives a very great gain in economy. This practice has been adopted on most of the American naval vessels.

Although the Diesel engine runs at approximately the same speed as that of the propeller, still, electrical transmission can be usefully employed even on Diesel ships. The advantages are that the engine can be subdivided into smaller units, and can probably be run at higher speeds. The engines can also be started up light, and, once started, may be left running even when the ship is standing still. The engines also do not require to run in the reverse direction, as reversing can be done with the electrical equipment.

In the case of the ships being built by Cammell, Laird and the British Thomson-Houston Co., Ltd., for the United Fruit Co., a large amount of power is required for the refrigerating plant in addition to propelling the ship. In this case the Diesels are fitted with two sets of generators, one set being used for propelling and the other for supplying power to the freezing plant. By using direct-current machinery, the engines can run at full speed at whatever speed the ship is running, and therefore full power is always available for the freezing plant.

A very successful example of an alternating-current ship is the *San Benito*, which also belongs to the United Fruit Co. This ship was built about two years ago by Messrs. Workman, Clark & Co., and equipped by the B.T.H. Co., and she has been running between Boston and the West Indies very successfully.

Recent Developments in the Application of Wireless Telegraphy to Shipping.

By Capt. John A. Slee, C.B.E.

(Abstract of paper read before Section G—Engineering).

The very heavy traffic handled by the largest of the trans-Atlantic liners has brought about requirements for automatic transmission and reception in order that the large number of messages with which they have to deal may be handled without monopolising the attention of coast stations for an unwarrantably long period. The method adopted for obtaining high speed transmission in ships is as follows:—The aerial circuit is magnetically coupled to a closed circuit which is kept in a state of constant oscillation by the transmitting valve. The coupling between the closed and open circuits is arranged in two equal parts which are opposed to one another. The act of signalling consists in short-circuiting one half of this coupling and so allowing the transfer of energy from the closed to the aerial circuit to take place through the remaining unbalanced portion. In order to keep the load on the transmitting valve constant, an artificial resistance is inserted in the closed circuit, which is short-circuited at the same moment that the compensating half of the coupling coil is short-circuited. This allows of fairly high-speed transmission without the slightest trouble from sparking at the key contacts. Speeds from 60 to 90 words a minute are worked as the circumstances of the moment may dictate. The source of supply is the standard nominal 1½-kW valve transmitting panel, the supply to the anode of the transmitting valve being approximately 1.2 kW. The aerial current for a prolonged dash is about 7 A, and the effective range of transmission at 90 words a minute is about 700 miles. The high-speed keying is carried out by means of a Wheatstone or Creed transmitter working from a perforated tape.

The high-speed receiving apparatus consists first of all of the usual loosely coupled circuits tuned to the frequency of the wave which it is desired to read, the high-frequency current being amplified by six valves working in a transformer-coupled amplifier of the well-known "55" type. The amplified current is acted upon by a local oscillator, the tuning of which is arranged to be very accurate, a tangent screw being fitted to the adjustable condenser in order that the beat frequency may be fixed with great accuracy. After rectification, the current now at the beat frequency is passed through a four-stage low-frequency tuning circuit. This consists of a four-valve low-frequency amplifier, each of the grid circuits being tuned to the predetermined beat frequency, the anode circuit of one valve being loosely coupled to the grid circuit of the next. After passing through the filter, the signals are again rectified and applied to the grid of the valve which operates the recording device. The anode current from this last valve is used to actuate the recorder, the current being to all intents and purposes a direct current whose strength varies between practically zero and about 5 mA. Extremely satis-

factory results have been obtained at sea from undulators of the type introduced by Dr. MacLachlan. These are very reliable in operation, and completely proof against vibration and movement of the ship. Receiving speeds up to about 100 words per minute can be attained by the means described above when signals are strong. Double reception, that is to say, reception of signals on two different wave lengths at the same time in the same ship, is now a common practice in these very large vessels.

The recent rapid increase in the number of powerful wireless stations has made the reading of Press messages in ships at sea exceedingly difficult, because there are many parts of the ocean where the received high-frequency currents from the station whose messages it is desired to read are very much weaker than the high-frequency currents received from other stations of very slightly different wave length. To overcome this difficulty, two-stage note filters, similar in principle to the four-stage note filters described above, are now in use. These note filters are only of practical use for reading continuous-wave messages in which the pitch of the note received can be varied at will by an alteration of the frequency of the local oscillations, and thus adjusted so that the desired signal is received at the beat note corresponding to the selective frequency of the filter.

A great step in the adaptation of wireless telegraphy as an assistance to navigation has been taken in the production of what are known as "revolving beam" stations. These stations transmit a signal on an exceedingly short wave (about six metres) in the form of a very fairly concentrated beam, and the whole apparatus of the transmitter can be rotated bodily on a turn-table.

Special instruments can be fitted for the reception of the signals sent out by the revolving beam transmitter. This altogether abnormal form of telegraphy is entirely free from the interference from other signals, and in consequence there is no difficulty in reading simple signals such as the single letters transmitted by its aid. The arrangements of the beam transmitter are such that signals will fall to about half their maximum strength about 10 degrees each side of the axis of the beam, falling away to practically zero a further 10 degrees each side of the axis. The method of signalling bearings by means of the beam is as follows:—As the projector is rotated a contact finger passes over studs on the turn-table, which

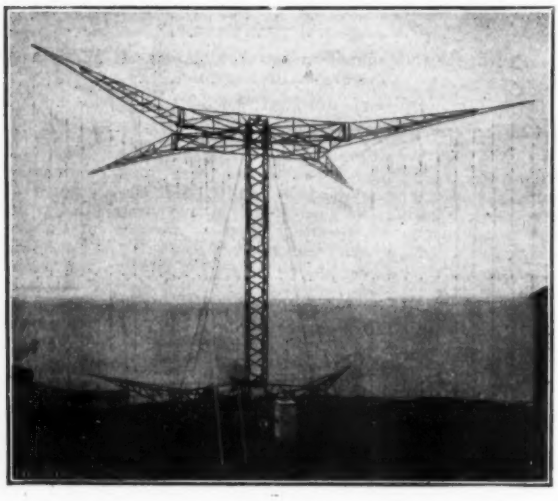

FIG. 1.—THE INCHKEITH "REVOLVING BEAM" STATION.

are arranged so as to produce a different letter, selected from the longer Morse letters, at each two points of the compass. A ship at the normal working range of the beam would thus hear either two of these long letters fairly loudly, in which case the bearing would be between them, or she would hear one long letter faintly then one loudly and a third faintly. This gives a rough indication of the bearing, but in order to allow of the bearings being read with a degree of accuracy sufficient for navigational purposes, the arcs between the long letters are split up by three equally spaced short letters, each of which, of course, will represent a half point of the compass. The letters in use are a T (one long) at the intervening points of the compass and an I (two shorts) at the intervening half points of the compass.

With the receiving instrument a disk is provided marked in half points of the compass and fitted with two pegs which the observer can plug into the disk at the first and last sound which he hears and he can then rest assured that the bearing will be midway between the points indicated by the two pegs. This gives an accuracy of bearing of a quarter of a point.

One such station exists at Inchkeith Island (fig. 1), and a second is being erected at the South Foreland lightship. The whole subject is still in its infancy, but it is felt that the use of this great boon to navigators will extend rapidly in the near future. At present the range at which bearings can be obtained with accuracy and certainty is about 10 miles, and it has been shown that although the range of the beam may be reduced by the presence of intervening obstacles, yet there is no action tending to distort the path of the beam, and therefore this method of giving directions is not susceptible to any electrical error.

There is a steady improvement in the accuracy of the long-range direction finders in seagoing ships. These instruments are intended to obtain a bearing of any vessel or coast station, making use of their ordinary wireless transmitter. Their available range is nominally 100 miles, which is about the greatest distance of real value to navigation, although accurate bearings are often obtained at three times this distance.

The causes of error of direction finders themselves are understood, and can be eliminated or compensated for, and consequently reliance can be placed upon the performance of the instrument, and it has become possible to mark out certain areas in which direction finder bearings of some shore stations are liable to error due to external causes.

There are two distinct methods of providing "duplex" radio-telephony. According to one of them, each station transmits on one wave and receives upon another, which differ from one another so widely that the transmitter can be arranged to have little or no effect upon the receiving instruments of the same station. This method is simple, but it is very prone both to cause and to suffer from interference, due to the fact that two very widely differing waves are employed for the purpose. A second method is to make use of two waves near to one another, so chosen that the beat frequency will be above human hearing. This method possesses many advantages, the only difficulty being that of making use of more than a very moderate amount of power.

Experiments are in hand with a view to linking up vessels within a moderate distance of their terminal ports (say, 50 miles) with the local Post Office telephone exchange system. There is no particular difficulty in obtaining and maintaining good telephonic speech with the wireless telephone station on land, the real complexity of the problem arising when the land telephone station has to be operated by subscribers at greatly varying distances from the exchange, as it is necessary that speech should reach the wireless telephone transmitter at some fairly definite intensity in order that distortion on the one hand and faintness on the other may be avoided. The same remark applies to the intensity of speech which must be handed over from the wireless telephone receiver to the land line telephone system. In order that the matter may be placed on an economic basis, it is necessary that the land telephone apparatus should work unwatched, and the experiments now in hand are directed mainly at overcoming the troubles outlined above.

Mercury Arc Rectifiers.

By R. L. MORRISON, A.M.I.E.E.

(Abstract of paper read before Section G—Engineering).

THIS paper followed closely upon the lines of that which appeared in the ELECTRICAL REVIEW during March, 1922.

The author claimed that the mercury arc rectifier was pre-eminent as a converter for the production of high-pressure direct current on account of the ease with which the pressures employed could be handled, its high overall efficiency, and its low maintenance and attendance charges. He described the valve action upon which the rectifier depended, due to the arrangement of two electrodes whereby one (the cathode) was raised to a high temperature (about 3,000 deg. C.), and the other (the anode) was maintained at a temperature below that at which the formation of electrons was possible (about 400-600 deg. C.). Mercury was used on account of the ease with which its vapour could be condensed and led back to the cathode. It was seen how the two halves of the a.c. wave were used by the employment of a number of electrodes, the six-phase arrangement being said to be the most satisfactory. The methods of construction were detailed, and it was shown how an auxiliary electrode was used to start the arc by tilting and allowing the mercury to flow between the electrodes. Cooling and exhaustion were described, and following this was a concise statement regarding the regulation and parallel operation of rectifiers. Very high momentary overloads could be dealt with, and this made it possible to use rectifiers of a much lower continuous rating than equivalent rotary converters. During short-circuit tests upon a rectifier with a normal current rating of 400 A, a current of 8,700 A was applied before the protecting cut-out cleared. Such momentary currents had no effect upon the rectifier, which could be switched in again immediately afterwards. As regarded efficiency, it was stated that in the largest 500 V, d.c. type, about 95.5 per cent. was obtained, while in the 1,500 V rectifier the efficiency was as much as 98.4 per cent.

Reference was made to the h.p. plant installed for the Midi Railway of France. There were in all 16 sets rated at 1,200 kW each, the d.c. working pressure being 1,575 V at full load. The efficiency varied from about 93.2 per cent. at quarter load to 95 per cent. at 50 per cent. overload. The guaranteed figures were 92 per cent. and 95 per cent. respectively under the two load conditions. The power factor on overload was 96.5 per cent., at half load 90.5 per cent. and at quarter load 80.5 per cent. The last figure was lower than that usually

obtained, and was due to these particular rectifiers being arranged for a twelve-phase connection, which necessitated a more complicated arrangement of choking coils. The usual figures to be expected between full and quarter load were about 85 and 90 per cent. The regulation was also good; at very low loads of about 100 A (d.c.) with a primary pressure of 7,800 V, the d.c. pressure was 1,680 volts, while at full load (about 790 A) it was 1,598 V, the primary pressure being 7,650 V. By making the necessary correction for a constant primary pressure of 7,800 V, an inherent regulation of approximately 3 per cent. was obtained.

As regarded overload capacity, the requirements were 50 per cent. for two hours and 200 per cent. for five minutes. These were easily obtainable without practically any perceptible additional heating. To demonstrate the capacity of the plant to withstand short circuits, ten were applied to one-minute intervals. These were also easily carried without having any effect whatever on the rectifiers.

Mention was made of tests upon high-pressure rectifiers. The first test on one of the new types was made at 2,500 V, d.c., with a current of 450 A (1,125 kW in a single cylinder). The pressure was then raised to 3,500 V and the current reduced to 350 A (1,225 kW), and finally it was increased to 5,400 V and a current of 300 A (1,620 kW). The rectifier was run for some considerable time at each of the voltages referred to. As d.c. motors for terminal pressures of 2,000 V could be built to operate perfectly satisfactorily, there was no reason why d.c. main-line electrification pressures should not be pushed up to 4,000 V.

Stated very briefly, the following were the main advantages obtained by the use of this class of plant:—(1) Efficiency high over the whole working range; (2) simple operation and attention a minimum; (3) no synchronising; (4) very high momentary overload capacity and insensibility to short-circuits; (5) negligible maintenance; (6) low weight, no special foundations; (7) noiseless and vibrationless operation, consequently rectifier sub-stations could be erected in densely-populated localities; and (8) new sub-stations need only be of light construction. In many cases old houses could be converted, while the plant could often be erected in places that could not be considered for rotating machinery. For instance, a 240-kW set complete was erected in the basement of the North Metropolitan Company's showroom at St. Albans.

The number of stations equipped with rectifiers up to the end of June, 1923, was 192, comprising 396 cylinders with an aggregate capacity of 104,500 kW. In this country there were a number of rectifiers in operation. Among the chief were mentioned: Glasgow (1,400 kW), St. Pancras (two at 900 kW), Battersea (two at 415 kW), and Birmingham, Liverpool, Wolverhampton, Hertford, and St. Albans, all about 230 kW each.

Among the more recent orders was one from the London, Midland & Scottish Railway for two 500-kW sets to operate at 2,300 volts, d.c. These would be the first high-pressure rectifiers to be installed in this country.

In conclusion, the author said that in the future it would probably be to such a plant as the rectifier that we would look for the solution of our conversion problems. Although rotating machinery used for the same purpose had been brought to a very high state of perfection, yet it was admitted by those concerned with the operation of such plant that something simpler was desirable, and something which would materially reduce attendance and maintenance charges. This need could only be adequately fulfilled by a stationary plant, and it could now be said without hesitation that the high power mercury arc rectifier fulfilled the requirements.

THE SHIPPING, ENGINEERING, AND MACHINERY EXHIBITION.

(*Concluded from p. 409.*)

Messrs. Babcock & Wilcox, Ltd., show in operation a patent mechanical chain-grate stoker of the compartment type, and in addition there are models of land- and marine-type boilers, oil fuel burners, high-pressure steam piping, &c.

The Lanston Monotype Corporation, Ltd., exhibits a varied collection of its products, including the "Safe-Economy" electric iron with a patent grip switch, and the same switch applied to other articles. A "Radbore" drilling attachment for boring square holes is also shown.

The Telephone Manufacturing Co., Ltd., shows a number of intercommunicating telephone sets, "Laryngophones," &c.

The Lea Recorder Co., Ltd., includes among its exhibits its patent coal meter (described in our issue of June 1st, p. 874), boiler feed-water measuring apparatus, a standard water flow recorder, &c.

Messrs. Ronald Trist & Co., Ltd., show the "Raybeam" water-gauge illuminator and the "Thermofeed" apparatus for automatically regulating the feed to boilers and controlling the pumps.

Messrs. E. Green, Ltd., have examples and models of their well-known economisers.

Messrs. Drummond Bros., Ltd., have a display of paraffin engine-driven machinery, including the "Willing Worker" 1-kW lighting set, a portable equipment driven by a 3-b.h.p. paraffin engine.

Newall's Insulation Co., Ltd., exhibit examples of the application of their magnesia and cork heat and steam insulating materials.

Messrs. B. J. Hall & Co., Ltd., show drawing office appliances and photo-printing equipment, including the "Hall-Mark" copier, which has already been described in the Electrical Review.

The Auto Welding & Engineering Co., Ltd., display coated electrodes for welding; specimens of welded work; and grinding and polishing motors with flexible shafts.

Messrs. C. O. Peters & Co., Ltd., demonstrate the "Wilson plastic arc" system of welding, in which the current is automatically controlled and regulated.

Messrs. James Howden, Ltd., have, among other things, a 30-kW engine-driven ships' lighting set and a 250-kW dynamo driven by a turbine through reduction gearing.

The De Laval, Chadburn Co., Ltd., shows a number of oil purifying apparatus, including the De Laval centrifugal separator, fully described in our issue of September 16th, 1921 (p. 388).

Messrs. Harfield & Co., Ltd., show two electric winches of the spur- and worm-geared types. The former is provided with a centre lifting barrel and two warping drums on the main shaft. These may be worked together or independently, by means of a clutch which connects the centre barrel to the shaft. The double reduction and two-speed gearing is run in an oil-bath, and fully protected by its casing from dust and water. The electrical equipment consists of a motor, of watertight construction, fitted with roller bearings; a totally-enclosed magnetic brake fitted to the commutator end bracket; and a watertight drum controller. The worm-geared winch is of similar design. A double ball thrust bearing is provided to take the thrust of the worm. The motor includes magnetic and centrifugal brakes, and the controller is of the contactor type. The operation of the foot-brake lever automatically cuts off the supply to the motor.

Messrs. Matthew Keenan & Co., Ltd., exhibit many steam plant accessories, including Gush's electrolytic system of boiler protection. This system involves the use of a special type of insulated current-conveying and anode-supporting bolt, and of an insulating material which retains its properties when exposed to the action of steam and water at all temperatures up to 500 deg. F. A small current is supplied from accumulators to metallic anodes submerged in the boiler water or condenser circulating water. These anodes and connections are insulated from the boiler or condenser steel. It is claimed that the passage of the current through the water continuously prevents the formation of scale and corrosion.

Messrs. Allen-Liversidge, Ltd., demonstrate the "Lincoln" arc-welding system, an American process which has been referred to in our columns. In the generator employed with this set the series field winding is connected so as to oppose a separately excited field. By means of a shunt and rheostat the amount of opposition produced by the series field may be regulated. By this means the voltage is reduced to welding strength when the arc is struck, and the machine is automatically regulated. One of the principal developments of the system comprises a motor-driven feeding arrangement by which lengths of metal can be welded at a uniform rate.

British Separators, Ltd., display the "Vickcen" centrifugal separator. This is of a type hitherto made abroad, and it is claimed that the "Vickcen" is the first purely British machine of its kind.

Messrs. Lacy-Hulbert & Co., Ltd., show electrically-driven pumping and compressing machinery, including the "Boreas" portable electric tire inflator which is driven by a ½-h.p. electric motor, and is capable of inflating an ordinary automobile tire to a pressure of 70 lb. in 30 or 40 seconds. Another exhibit is the "Boreas" electrical air blast, in which a rotary blower is chain driven by an electric motor.

British Electric Vehicles, Ltd., has examples of its trucks and locomotives. These are a 5,000-lb. "S.G." spring model truck for docks, &c., and a small electric locomotive of the battery type, weiging 2¼ tons.

Walker Vehicles, Ltd., also shows trucks; these are of the "Railodok" pattern for both carriage and traction of goods.

Steam Plant Accessories, Ltd., displays steam valves, injectors, gauges, oil-burning equipment, and other appliances for use with steam installations.

The Elkay Electrical Manufacturing Co., Ltd., has a large collection of tumbler switches, combined switches and fuses; knife switches for currents up to 3,000 A; house-service meters; cable joint boxes; and high-pressure overhead apparatus, as disconnectors, horn type switches, insulators, &c. Two or three very large 3-phase switches of Danish manufacture are on view; these deal with pressures up to 24,000 V and currents up to 200 A. They are fitted with overload and no-volt releases, and, if required, remote control.

W. R. Patents, Ltd., exhibits fuel-saving appliances, including the "W.R." combustion recorder.

Messrs. Goodyear & Sons, Ltd., show the latest models of "Greenbat" 2-ton electric industrial trucks, including the lifting platform type.

Werf Gusto, Firma A. F. Smulders (Rotterdam) have two models of electrically-operated floating cranes, as supplied to English docks, for dealing with loads of 200 and 150 tons respectively.

The Anglo-Swedish Welding Co., Ltd., shows examples of work produced by means of the Kjellberg system of arc welding.

The Midland Dynamo & Motor Repairs Co., Ltd., shows in operation a "Quickway" coil-winding and forming machine, which turns out coils to suit almost any armature or stator ready for taping.

The Scholey Construction Co., Ltd., shows welding machines, dynamotors, electrodes, &c. One of the main exhbitis is a "Daysohms" low-pressure a.c. arc welder which is designed to work from ordinary supply circuits. It has a 5-kVA step-down transformer, the secondary of which gives a current range of from 20 to 50 A at an open-circuit pressure of 50 V. One essential feature is an automatic choker which increases in effect after the arc is struck, the adjustment being continuous, not graduated. Ordinarily, sheet steel up to ¼ in. thickness can be welded with the machine, but in certain circumstances it can accomplish harder tasks.

Mr. H. C. Slingsby has upon his stand electrical industrial trucks, including the elevating platform type, and a small electric locomotive.

The London Electric Wire Co. & Smiths, Ltd., exhibit many types of wire for electrical purposes, including insulated wire for motors, generators, and magnetos.

Messrs. Ransomes, Sims & Jefferies, Ltd., again show their "Orwell" electric trucks, and the patent runabout crane which was described in our issue of February 16th last. The crane is a very mobile goods-handling machine which can easily be employed in shops of comparatively small size.

Messrs. Ruston & Hornsby, Ltd., have as their principal exhibit a three-cylinder, 165-b.h.p., cold-starting, vertical oil engine. This is designed to run on the lowest grade oil fuels, and has a guaranteed consumption of about .42 lb. per b.h.p.-hour. The fuel is injected by positively-driven pumps, and passes through a patent atomiser which converts it into a finely divided spray.

The Parsons Marine Steam Turbine Co., Ltd., exhibits a working model of a double-reduction geared turbine, other models, and examples of gears.

Messrs. Boulton & Paul, Ltd., have as their main exhibit a water elevator, consisting of a cellular endless band. Another exhibit shown is the semi-automatic "Electolite" set for country-house lighting, consisting of a 1.5-kV d.c. generator, driven by a petrol-paraffin engine, and a drum-controller type switchboard.

United Water Softeners, Ltd., has a large display of plant and materials for the softening and purifying of water, centrifugal oil separators, &c.

The Sperry Gyroscope Co., Ltd., shows gyroscopic stabilisers, compasses, automatic course recorders, &c., and a high-intensity searchlight designed for small naval craft or merchant vessels. This has an 18-in. diameter projector, and a stated beam candle-power of 40,000,000.

Messrs. A. C. Alexandra & Co., Ltd., show a standard type of rivet heater with three heating heads, and adjustment for twelve different "heats." It is claimed that 500 rivets of ⅝ in. diameter can be handled per hour by an unskilled operator using the machine.

The Staines Kitchen Equipment Co., Ltd., amongst a wide variety of domestic appliances shows the "Ireland" glass-wiping machine, previously described in our columns, consisting of a motor-driven combination of four rotary wipers into which the glass is placed and cleaned. The firm also has a small electrical refrigerator, of simple construction, suitable for household purposes.

Messrs. E. W. Farrow & Sons, show, *inter alia*, a 1-kW generating set, consisting of a vertical open-type engine, direct-coupled to a compound-wound generator, designed to give its rated output at a speed of 700 r.p.m.

Messrs. Stuart Turner, Ltd., are showing, in use, their .5-kW lighting set. The motive power is provided by a 1-b.h.p. two-stroke petrol engine of the three port type, which dispenses with valves, tappets, &c. The magneto is directly driven by the crankshaft through a flexible coupling, and the generator is also directly coupled in the same way. The dynamo runs at 1,200 r.p.m., giving its rated output at a pressure of 25 V. A 14-cell, 100-Ah battery is supplied. The switchboard, an enamelled slate panel, bears two ammeters, a voltmeter, fuses and single pole switches for the dynamo and external circuits, battery and shunt regulators, and an automatic cut-out. In addition to this the firm shows a 1½-kW set suitable for yachts or small buildings, and a 1.5-kW for larger houses, as well as lighting fittings, &c.

Messrs. Watts, Fincham & Co., Ltd., have a varied exhibit of ship's deck, engine room, and cabin accessories, among which is the "Wefco" gas-proof safety hand lamp for employment aboard oil tankers, &c.

Messrs. Newton Bros (Derby), Ltd., show d.c. and squirrel cage and slip-ring a.c. motors. A distinctive feature of the stand is the working example of the "Newton Derby" patent reversing gear, which finds its principal application in the drive of planing machines.

Ozonair, Ltd., has examples of its ventilation plant, including a 6,000 cu. ft. per minute apparatus for public buildings, consisting of an air washer, a cased centrifugal fan, electric motor, and ozone plant.

Messrs. Henry Joseph & Co. have a collection of vitreous porcelain insulators for various applications, numerous electrical accessories, and cabinets for radio apparatus.

Messrs. Worsnop & Co., Ltd., exhibit a number of types of "Alklum" nickel-steel accumulators.

The Record Engineering Co., Ltd., shows applications of its "Silent Record" engines, including a 16-kW emergency generating set for use on board ship.

Messrs. John Gibbs & Son, Ltd., display ventilating plant, including several examples of their electric fans, many of which are fitted with patent dustproof and watertight motors. A number of interlocking double-pole starting and regulating switches are also shown by the firm.

The Foster Instrument Co., exhibits pyrometer equipment, including base and rare metal thermo-couples, electric resistance thermometers, &c.

The Rawlplug Co., Ltd., has its usual display of "Rawlplugs" and their many applications, as well as recess screws.

Messrs. Crosbie & de Mowbray, Ltd., show small (12-W) lighting sets, heating appliances, fans, lighting fittings, and other electrical accessories.

Simms Motor Units (1922), Ltd., demonstrates high- and low-pressure magnetos, sparking plugs, and similar apparatus.

Messrs. North & Sons, Ltd., also show magnetos (the "Watford" type), revolution indicators, &c.

The British Arc Welding Co., Ltd., displays examples of welded work.

The Reliance Telephone Co., Ltd., has a comprehensive exhibit of telephone, signalling, and alarm systems. This includes intercommunication telephones, transmitters of the "Laryngophone" type, and a complete Western Electric automatic exchange.

Edison Accumulators, Ltd., shows examples of its well-known nickel-iron accumulators, designed for various purposes—vehicle propulsion, lighting, &c.

Messrs. George Kent, Ltd., show Venturi meters, water-level recorders, water meters, manometers, steam meters, and other power station accessories.

Messrs. Walker, Crosweller & Co. also show apparatus for use in power stations, including "Arkon" draught and pressure gauges, and CO_2 recorders. A new type of the latter is an all-metal apparatus which does away with the constant breakages which occur where many glass vessels and tubes are used.

Messrs. Ross, Courtney & Co., Ltd., in addition to hydraulic apparatus, show numerous types of terminal, including a sparking plug connection which dispenses with nuts by using a spring grip device.

Peugeot (England), Ltd., shows internal combustion engines, including one driving a small generator.

Messrs. Morris, Henty & Gardners, Ltd., have on their stand many examples of the well-known "Gardner" engine, including lighting sets of 1½-kW and 3-kW capacity.

The Atlantic Engine Co (1920), Ltd., also shows a lighting set, consisting of a 4-b.h.p., single-cylinder, petrol-paraffin engine, directly coupled to a 2-kW Crompton generator.

The Parsons Motor Co., Ltd., shows a larger generating set, comprising a 14-h.p. "Parsons" engine directly coupled to a 7.5-kW "E.C.C." generator. An electric welding plant provided with a 14-h.p. engine, and a Metropolitan-Vickers generator is also exhibited.

The Aster Engineering Co. (1913), Ltd., is another firm showing lighting plant. It has examples ranging in capacity from 4 to 25 kW, and a semi-portable arc welding plant is also shown.

Messrs. J. W. Brooke & Co., Ltd., and John I. Thornycroft & Co., Ltd., also have lighting sets among their exhibits.

Messrs. C. A. Vandervell & Co., Ltd., show electric lighting, starting, and ignition apparatus for automobiles, and accumulators employing threaded rubber insulation.

The Concordia Electric Wire Co., Ltd., has a good show of wires for electrical purposes—bare and insulated, including nickel-copper, nickel-chrome, and other special wires.

Burlectas, Ltd., exhibits examples of artistic table standards for electric lighting.

Messrs. Buckley, Saunders & Co., Ltd., have a very comprehensive selection of welding apparatus. Notable among this is a chain-welding machine in which two current-carrying points close up upon the link joint, while at the same time two swaging blocks at right angles to these also come into action, making a very sound weld. An automatic feeding device is incorporated in the machine, enabling No. 3 chain to be welded at the rate of 25 links per minute.

There is a single-operator motor-generator set of 170-A capacity, suitable for the heaviest type of arc welding supplied as a portable or semi-portable machine; and an a.c. transformer arc welding set of 200 A capacity, suitable for connecting to single, 2-phase or 3-phase supply.

An outstanding feature is the a.c. transformer set which is a compound unit complete in itself and although suitable for the heaviest class of arc welding with a 200-A capacity, only weighs just over 300 lb. It is fitted with ammeter, suitable terminals for welding leads, and double-pole switch and fuses. Regulation of current is obtained by means of an adjusting wheel on top of the apparatus. Wheels and a slinging device are fitted for portability. It is equally suitable for welding ¼ in. plate as for 1 in. Cast iron can also be efficiently welding by the use of the special "Ferro-Arc" cast-iron electrode, which deposits a fine, easily machineable, grey cast iron in the weld.

Another interesting exhibit is the semi-automatic butt welder, on which particularly efficient welds on copper wire can be consistently carried out. The time taken to make a weld is a fraction of that required for a brazed joint. The wire is placed in the jaws and the operating handle turned. Its capacity is mild steel, .02 to .25 in. dia.; copper, .02 to .128; brass, .02 to .19. The machine is now used by most of the large cable makers for joining the ends of reels of wire to give a continuous length. The saving is considerable, as compared with brazing, and the conductivity of the wire is unaffected. Other machines shown are a 3-kW butt welder, with automatic cut-off; 6-kW and 30-kW butt welders; 3-kW, 6-kW, and 10-kW spot welders; a trip.. 15-kW rivet heater; an 80-kW "Universal" welder; and a 15-kW power-driven seam welder.

The Swedish General Electric, Ltd., exhibits many examples of its manufactures, including two type "K" shunt-wound, interpole, d.c. motors, and two type "MK" three-phase, slip-ring, induction motors, of 9 h.p. and 5 h.p. in size. These motors are fitted with drip-proof housing, and are designed to meet the requirements of heavy industrial work. The slip-rings are external, being provided with dust proof covers, and the motors are fitted with ball bearings. One of the most interesting machines on the stand is the three-phase, variable-speed commutator motor, type "FS." This machine has a very wide range of speed control, from three to one, and this is obtained by a simple brush shifting device which can be operated either mechanically or electrically. The speed is entirely independent of the load, and the efficiency and power factor remain at a high value for all speeds within the range of the machine.

The "Century" single-phase, self-starting, repulsion-induction motor, examples of which are shown, provides a useful type for direct coupling, owing to the very high starting torque developed. For lift work the company has developed a single-phase, reversible commutator motor, and one of these machines of 5 h.p. capacity is shown together with its controller.

Another interesting exhibit is a 250-h.p., three-phase motor, of the slip-ring type, wound for a speed of 480 r.p.m., on 3,000 V. This type of motor is provided with explosion proof slip-rings, and is especially designed for use in fiery mines. The remainder of the exhibit includes a 150-kVA, three-phase transformer, with the oil tank removed to show the general construction of the apparatus, and control gear of many types.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS AND MACHINERY IN AUGUST, 1923.

The August official returns of electrical exports and import business show as regards the exports a falling off of nearly £80,000 as compared with the previous month, the total being for August £859,657, as against £899,251 for July. This drop in value occurred in nearly all the principal items, but the returns show a large increase (£182,000) under the heading submarine telegraph and telephone cable, also increases in the batteries and accumulators and railway and tramway motor sections.

The electrical export totals for the first eight months of 1922 and 1923 were:—

Exports.	1922.	1923.
Electrical goods and apparatus ...	£4,858,198	£5,357,272
Electrical machinery	2,968,444	2,492,750
Total for eight months	£7,826,642	£7,850,022

The imports of electrical goods show considerable increase in business during August, the total, £241,056, comparing with £154,902 in July. Doubtless some portion of the August imports should have been included in the July total, but could not be owing to the strike at the docks; the increase is fairly well distributed, but is particularly marked in the electrical machinery section.

The electrical import figures for the first eight months of 1922 and 1923 were:—

Imports.	1922.	1923.
Electrical goods and apparatus ...	£868,975	£1,422,880
Electrical machinery	911,776	678,791
Total for eight months	£1,780,751	£2,101,671

The re-exports at £12,271, compared with £15,421 for the previous month, show a falling off of over £3,000, the principal decreases being recorded in the electrical machinery and telegraph and telephone cable and material sections.

Re-exports.	1922.	1923.
Electrical goods and apparatus	£123,148	£64,627
Electrical machinery	31,171	72,638
Total for eight months	£154,319	£137,265

	Exports. Electrical exports for August, 1923.	Inc. or dec. as compared with July, 1923.	Inc. or dec. as compared with August, 1922.	Imports. Electrical imports for August, 1923.	Inc. or dec. as compared with July, 1923.	Inc. or dec. as compared with August, 1922.	Re-Exports. Electrical re-exports for August, 1923.	Inc. or dec. as compared with July, 1923.	Inc. or dec. as compared with August, 1922.
Electrical goods and apparatus (unenumerated)	£62,798	− £55,846	− £42,588	£66,039	+ £4,475	+ £32,081	£3,654	+ £149	− £217
Insulated wires and cables ...	111,669	− 1,857	− 41,922	24,846	+ 6,467	+ 4,909	210	+ 97	+ 178
Glow lamps	20,706	− 4,505	− 17,102	13,766	+ 3,959	+ 3,173	298	− 469	− 411
Arc lamps and parts	91	− 1,124	− 138	977	− 801	+ 406	—	—	− 7
Batteries and accumulators ...	31,969	− 13,350	+ 6,760	12,478	+ 2,357	− 7,732	44	− 193	− 434
Meters and instruments ...	24,221	− 560	− 9,517	6,132	+ 147	+ 288	155	+ 18	− 1,080
Carbons	3,468	− 5,785	− 3,104	11,174	+ 5,428	+ 9,217	28	—	− 403
Electrical Machinery—									
Electrical machinery (unenumerated)	93,222	− 17,176	− 30,366	72,926	+ 67,181	− 102,008	6,711	− 1,370	+ 1,978
Railway and tramway motors	31,832	+ 1,680	+ 20,166	—	—	—	—	—	—
Other motors and generators ...	111,050	− 60,564	− 2,584	—	—	—	—	—	—
Switchboards (not telegraph or telephone)...	2,273	− 8,781	− 3,020	—	—	− 428	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cables (not submarine)	40,913	− 12,222	− 9,846	5,500	+ 3,598	+ 4,447	—	− 2,071	− 130
Submarine telegraph and telephone cable	220,557	+ 182,494	+ 173,775	—	—	—	—	—	—
Telegraph and telephone instruments and apparatus ...	104,888	− 41,998	− 44,501	27,218	− 6,657	− 21,729	1,171	+ 648	− 146
Totals	£859,657	− £39,594	− £3,980	£241,056	+ £86,154	− £77,376	£12,271	− £3,150	− £672

Increase or decrease for the eight months ended August, 1923 ...	Exports. + £23,380	Imports. + £320,920	Re-exports. − £17,054

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

21,985. "Spark-gap for diathermy high-frequency electric currents, &c." L. B. Hazleton. August 31st.
21,990. "Electric terminals." J. H. Brown and E. Scott. August 31st.
21,998. "Switching devices for telephone exchange systems." Western Electric Co., Ltd. (Western Electric, Inc.). August 31st.
22,007. "Electric furnaces." Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.). August 31st.
22,008. "Electric furnaces." Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.). August 31st.
22,009. "Electric furnaces." Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Manufacturing Co.). August 31st.
22,012. "Cements or pastes for incandescent lamp filaments, &c." British Thomson-Houston Co., Ltd. (General Electric Co.). August 31st.
22,024. "Resistances for electric heating." Morgan Crucible Co., Ltd., and C. W. Speirs. August 31st.
22,040. "Carrier device for electric connector plugs." A. Engel (née Bormann). August 31st. (Germany, August 31st, 1922.)
22,055. "Electric water heaters." G. W. Humphry. September 1st.
22,063. "Telephone exchange systems." Coventry Automatic Telephones, Ltd. (R. C. Arter and T. R. McGerty). September 1st.
22,069. "Electric switching devices." G. J. Moulder. September 1st.
22,073. "Wireless receiving apparatus." R. F. Cobb. September 1st.
22,109. "Variable electric condensers." F. E. Woodhead and H. L. Woodhead. September 3rd.
22,118. "Wireless receiving apparatus." J. P. Prangnell. September 3rd.
22,122. "Ignition systems for internal-combustion engines." J. H. Stewart. September 3rd.
22,127. "Sparking plugs." M. I. Yousif. September 3rd.
22,132. "Plug-in terminal." J. Bennett. September 3rd.
22,135. "Composite metals." British Thomson-Houston Co., Ltd. (General Electric Co.). September 3rd.
22,143. "Electric current transformers." Soc. de Paris et du Rhône. September 3rd. (France, January 31st.)
22,151. "Double-pole electrical connectors." C. E. Foster. September 3rd.
22,153. "Crystal rectifier." C. Arrigoni, J. Arrigoni, and F. W. Cox. September 3rd.
22,164. "Radio receiving apparatus." Johnson-Williamson Laboratories, Inc. September 3rd. (United States, September 25th, 1922.)
22,172. "Lightning switch for wireless telegraph, &c., instruments." C. F. Halsall. September 3rd.
22,180. "Loud speaker for wireless broadcast reception." C. E. Bateman. September 4th.
22,206. "Sound-amplifying horns." Fuller's United Electric Works, Ltd., and A. P. Welch. September 4th.
22,207. "Holders for thermionic valves." A. P. Welch. September 4th.
22,208. "Electromagnetic sound reproducers." Fuller's United Electric Works, Ltd., and A. P. Welch. September 4th.
22,225. "Relays for electric protective systems." W. Lulofs and A. Reyrolle & Co. September 4th.
22,229. "Wireless crystal detectors." W. Charstone and A. Pearmain. September 4th.
22,242. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. September 4th. (United States, Febrdary 2nd.)
22,247. "Variable inductance devices." A. H. Curtis, Igranic Electric Co., Ltd., and S. R. Wright. September 4th.
22,258. "Crystal detectors." H. B. Mosely, W. G. Turner, and W. G. Turner & Co. September 4th.
22,262. "Inductance, &c., coils for wireless telegraphy, &c." S. Calamatianos. September 4th. (Belgium, May 16th.)
22,289. "Automatic telephone systems." F. W. Davis, B. B. Johnson, and Relay Automatic Telephone Co., Ltd. September 4th.
22,292. "Electric power transmission systems." A. M. Taylor. September 5th.
22,305. "Electric switches." J. A. Crabtree. September 5th.
22,306. "Electric lighting, heating, or power circuit." H. F. Vickery (Neville). September 5th.
22,346. "Electric condensers." P. D. Tyres. September 5th.
22,347. "Rheostat." E. J. L. Delfosse. September 5th.
22,354. "Electrical oil-break switch." Forges et Ateliers de Constructions Electriques de Jeumont. September 5th. (France, February 22nd.)
22,357. "Glass-working apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). September 5th.
22,366. "burglar and fire alarm systems." C. A. Carpenter. September 5th.
22,372. "Apparatus for protecting rectifier installations from short circuits." Akt. Ges. Brown, Boveri et Cie. September 5th. (Germany, September 16th, 1922.)
22,376. "Electric lamps." C. M. Page. September 5th.
22,381. "Sound amplifier." W. H. Storey. September 5th.
22,385. "Electric switches." E. Watkinson. September 5th.
22,390. "Electric storage apparatus." Sir H. F. Heath and P. Kapitza. September 5th.
22,391. "Production of high-tension discharges." Sir H. F. Heath and P. Kapitza. September 5th.
22,392. "Flash illumination." Sir H. F. Heath and P. Kapitza. September 5th.
22,419. "Poles for supporting overhead electric conductors, &c." British Electrical & Allied Industries Research Association and E. B. Wedmore. September 6th.
22,422. "Wireless aerial applicable as fire-screen, &c." J. Dunn and M. MacGregor. September 6th.
22,428. "Device for shifting tramway points." W. F. McKay. September 6th.
22,437. "Electro-responsive devices." British Thomson-Houston Co., Ltd. September 6th.
22,445. "Microphones, &c." Signal Ges. September 6th. (Germany, September 7th, 1922.)
22,448. "Electric accumulators." H. M. Genese, Pritchett & Gold, and E.P.S. Co., Ltd. September 6th.
22,449. "Material in which electrical conductors are embodied." Grierson, Ltd., and J. L. Musgrave. September 6th.
22,456. "Sparking plugs." M. Pognon. September 6th. (France, July 26th.)
22,471. "Radio-frequency amplifier and transformer." Dubilier Condenser Co. (1921), Ltd. September 6th. (United States, September 6th, 1922.)
22,472. "Automatic operation of air-exhausting apparatus in mercury rectifiers." Akt. Ges. Brown, Boveri et Cie. September 6th. (Germany, September 9th, 1922.)
22,473. "Electro-responsive devices." A. S. FitzGerald. September 6th.
22,474. "Electro-magnetic relays." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. September 6th.
22,477. "Telautographic transmission of hand-writing, &c." A. Korn. September 6th.
22,484. "Aerials for wireless signalling." C. S. Franklin. September 6th.
22,487. "Magnetic alloys for telegraphic, &c., cables." H. J. Garnett and W. S. Smith. September 6th.
22,488. "Automatic telephone systems." T. M. Inman, Relay Automatic Telephone Co., Ltd., and R. H. Vanneck. September 6th.
22,494. "Circuits for transmission of wireless telegraph signals," &c. H. A. Madge. September 7th.
22,515. "Control of electric cranes, &c." B. Nelson and D. Robinson. September 7th.
22,519. "Magnetos or dynamos." F. L. Hollister. September 7th.
22,520. "Electric lamps." F. L. Hollister. September 7th.
22,532. "Electrical heating apparatus." J. K. Quain. September 7th.
22,533. "Electrical heating apparatus." J. K. Quain. September 7th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

4,982. "Printing telegraphs." Soc. Française Radio-Electrique. March 29th, 1921. (177,769.)
10,245. "Actuation of electric cut-outs." F. H. Leffler and A. C. Barton. February 3rd, 1923. (202,671.)
11,762. "Detachable electric lighting fittings." E. Isherwood. April 27th, 1922. (202,685.)
13,763. "Receiving apparatus for wireless and other tuned telegraphy and telephony." J. B. Bolitho. May 16th, 1922. (Cognate application 7,606/23) (202,700.)
13,967. "Locking-device for electric lamps and adapters for attachment to bayonet lamp holders, in conjunction with a tool for operating same." W. J. Birnie. May 18th, 1922. (202,704.)
14,147. "Illuminated indicating devices." E. T. R. Murray and L. E. R. Murray. May 19th, 1922. (202,707.)
14,449. "Gas heating apparatus, also applicable to electric heating apparatus to enable them to be converted into cooking apparatus." A. G. Mill. May 23rd, 1922. (202,716.)
14,678. "Directional wireless systems and apparatus." J. Robinson, H. L. Crowther and W. H. Derriman. May 25th, 1922. (202,733.)
14,974. "Electric relays." British Thomson-Houston Co., Ltd. (General Electric Co.). May 27th, 1922. (202,744.)
15,004. "Electric transmission systems." A. M. Taylor. May 29th, 1922. (Addition to 195,429.) (202,746.)
15,330. "Electric switch devices." T. W. Bennett. May 31st, 1922. (202,755.)
15,481. "Automatic telegraphy." E. S. Heurtley and Muirhead & Co., Ltd. June 1st, 1922. (202,759.)
15,483. "Connections for electric wires." British Battery Co., Ltd., and J. W. H. Reynolds. June 2nd, 1922. (202,760.)
15,845. "Telephone systems." Western Electric Co., Ltd. June 10th, 1921. (181,705.)
15,926. "Semi-automatic electric lighting systems and switchboards therefor." M. Webber, Ltd., and R. S. C. Ball. June 8th, 1922. (202,768.)
16,065. "Electrical marine propulsion." A. B. Field and Metropolitan-Vickers Electrical Co., Ltd. June 9th, 1922. (Cognate application 17,928/22.) (202,771.)
16,157. "Electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co.). June 10th, 1922. (Addition to 201,629.) (202,774.)
16,357. "Revolving illuminated pillars for advertising purposes." G. Robertson. June 13th, 1922. (202,777.)
16,396. "Automobile headlamps and the like." H. R. Lanyon. June 13th, 1922. (202,779.)
16,506. "Floor-indicating mechanism for elevators." F. F. Clouser and A. M. Harness. June 14th, 1921. (181,714.)
16,562. "Ignition apparatus for internal-combustion engines." C. T. Hill. June 15th, 1922. (202,783.)
16,591. "Electrical signalling methods." F. E. Pernot. June 15th, 1922. (202,784.)
16,782. "Motor-car headlights and the like." C. Zeiss (firm of). June 21st, 1921. (182,111.)
16,934. "Electric motor controlling apparatus." Waygood-Otis, Ltd. (Otis Elevator Co.). June 19th, 1922. (202,786.)
17,833. "Change-over switches for electric lighting and other installations for railway carriages and other vehicles." J. Stone & Co., Ltd., and A. H. Darker. June 28th, 1922. (202,797.)
18,358. "Electric heating devices." British Thomson-Houston Co., Ltd. (General Electric Co.). July 4th, 1922. (202,801.)
18,742. "Electrical measuring instruments." T. Mather. July 8th, 1922. (202,806.)
19,398. "Multi-colour street standard advertising lamp." E. G. Casey. July 14th, 1922. (202,808.)
19,977. "Servo-motors." P. Salmon. July 20th, 1922. (202,814.)
20,079. "Electric switches." A. G. Davies. July 22nd, 1922. (202,815.)
20,529. "Telephone receivers." E. W. Pattison (Dictograph Products Corporation). July 27th, 1922. (202,818.)
21,378. "Means for controlling the voltage of the alternating-current supplied to a valve generator." Ges. für Drahtlose Telegraphie. August 5th, 1921. (184,195.)
22,309. "Electric switches." J. B. Hansell and Metropolitan-Vickers Electrical Co., Ltd. August 16th, 1922. (202,833.)
23,041. "Automatic electric sub-station systems." G. A. Cheetham and Metropolitan-Vickers Electrical Co., Ltd. August 24th, 1922. (202,842.)
23,168. "Alternating-current and continuous current converters." K. F. Blaser and E. Blaser. August 25th, 1922. (202,845.)
24,614. "Combined electric lamps and magneto-electric generators therefor." O. Pletscher. September 21th, 1921. (185,761.)
27,071. "Method of and appliances for suspending aerial electric conductors." A. Renaudin. October 6th, 1921. (186,933.)
28,086. "Head-attachment gear for telephone receivers." British Thomson-Houston Co., Ltd., A. P. Young, and A. T. Stace. October 16th, 1922. (202,873.)
28,911. "Electric switches." Hoover Suction Sweeper Co., Ltd. (Hoover Suction Sweeper Co.). October 24th, 1922. (202,881.)
28,947. "Electrolytic apparatus." J. P. Scott. October 24th, 1922. (202,882.)
29,165. "Electrical ignition apparatus for internal-combustion engines." F. H. Royce and Rolls-Royce, Ltd. October 25th, 1922. (202,885.)
33,101. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). December 4th, 1922. (202,897.)
34,568. "Protective arrangements for electric distribution systems." British Thomson-Houston Co., Ltd. (General Electric Co.). December 16th, 1922. (202,901.)
34,556. "Control of trains." A. R. Angus. April 20th, 1922. (Divided application on 190,503.) (202,903.)
35,224. "Calling devices of the dial type for use in automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. December 30th, 1921. (191,056.)

1923.

3,519. "Belting for transmitting motion to motor fans, dynamos, and like purposes." F. G. Young. February 6th, 1923. (202,913.)
11,216. "Thermo-electric pyrometers." H. A. Daynes and Cambridge and Paul Instrument Co., Ltd. April 25th, 1923. (202,928.)
12,261. "Manufacture of storage battery separators." H. Wade. (Gould Storage Battery Co.). April 20th, 1922. (Divided application on 200,913.) (202,929.)
18,565. "Acoustic apparatus." H. Baron (Signal Ges.). February 6th, 1922. (Divided application on 176,764.) (202,938.)
19,019. "Printing telegraphs." Soc. Française Radio-Electrique. March 29th, 1921. (Divided application on 177,769.) (201,186.)